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FOUNDRY TRADE JOURNAL

EST. 1902

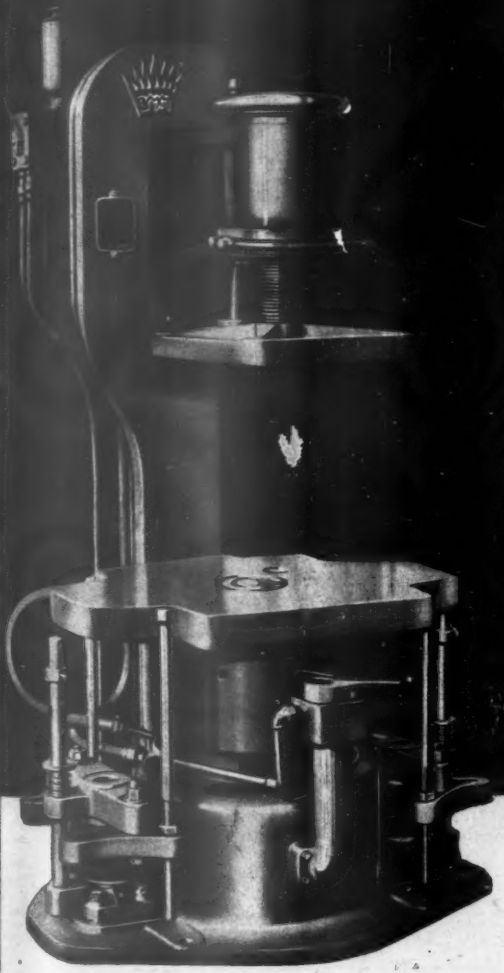
VOL. 99
No. 2030
Registered at the G.P.O. as a Newspaper

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

JULY 28, 1955

Offices: John Adam House, John Adam St., London, W.C.2

Single Copy, 9d. By Post 11d. Annual Subscription, Home 40/-, Abroad 45/- (Prepaid)



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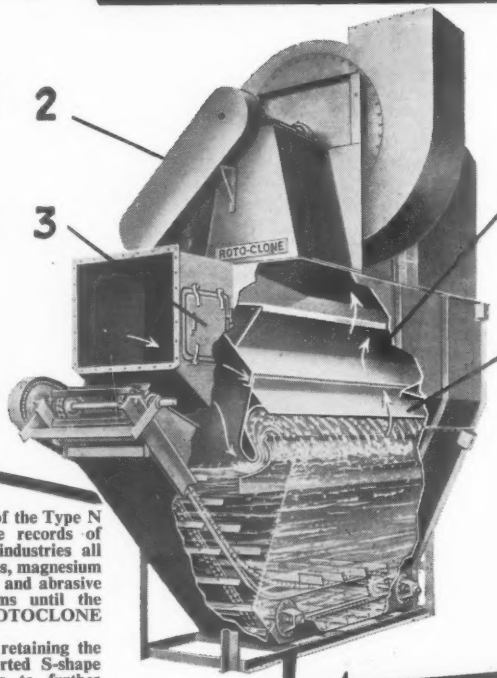

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FOUNDRY TRADE JOURNAL

Established 1902

Vol. 99 | Thursday, July 28, 1955 | No. 2030

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AN INDUSTRIAL NEWSPAPERS PUBLICATION

Published Weekly

Single copy 9d.: by post 11d.
Annual subscription : home 40s., abroad 45s. (prepaid).

JOHN ADAM HOUSE, ADELPHI, LONDON, W.C.2

'Phone: TRAfalgar 6171 (10 lines)
'Grams: Zacatecas, Rand. London.

The Same the World Over

It was during the first world war that the Editor installed in the works of the Fonderia Milanesi di Acciaio Vanzetti, an Electrometals electric-arc steelmelting furnace. During a holiday, by invitation of Dr. Dupuis, he had the opportunity of revisiting these 76-years-old works. Here in an interval of some 37 or 38 years was portrayed the development of the steelfoundry industry during that time. At the time of the first visit, the foundry operated a converter plant, a Bassanesi electric-furnace and the new Electrometals unit. Moulding—mostly by hand—was mainly green-sand, the larger jobs being stoved.

To-day, there are many changes in the foundry. Green-sand moulding is still practised, but half the production is made by the cement-sand process. The plant is now mechanized, using efficient moulding machines; an overhead sand supply and an American knock-out system. Quality has not been sacrificed, and castings with excellent surfaces are being made. The laboratory control compares favourably with the best in this country. It includes X-ray and gamma-ray installations, a heat-treatment laboratory, and chemical and physical laboratories of a high order. The magnet shop is quite imposing, and a battery of half-a-dozen or so high-frequency furnaces provide the metal. Thus the history of this Italian steel foundry—one of the oldest in Europe—is much the same as that of Lloyd's, Hadfields' or Edgar Allen's. There is the same story of development, using the newer machinery and processes as they become available, always taking into consideration the nature of the market served.

The foundry is fully conscious of its future. Ready for unpacking is a British shell-moulding plant, and the CO_2 process is being studied in detail. There was a great interest amongst the staff as to whether their production equalled the British and "did their men work as hard?" We gave it as our opinion that little difference could be observed. Perhaps because of climatic conditions, the men were not as well shod as they should be for handling liquid metal, but the operators have great experience and thereby risk is lessened. Our experience of Italian labour is that they take a little more training than ours, but when fully trained, are indeed excellent craftsmen. The patterns usually come from outside, but the workmanship put into them is obvious. One little thing we noticed, only applicable to one foundry in England, was that when cement moulding, all protrusions in the mould were painted with chromite. It was said to act as a densener. Finally, we wish to thank Dr. Dupuis and his colleagues for the many courtesies extended to us. They are, indeed, assiduously following the lead given them by their founder, Carlo Vanzetti, that great pioneer of the Italian steelfoundry industry.

IBF National Works Visits

In view of the outstanding success of the five previous annual national works visits days, the Council of the Institute of British Foundrymen has decided to repeat the function this year, and has accepted the offer of the Bristol and West of England branch to make the arrangements. These works visits supplement the arrangements which are already made by branches and those afforded at the annual conferences, and in particular enable those members who cannot spare the time to attend the whole of the annual conference to take part in an annual national gathering. It is hoped that other branches will assume responsibility for arrangements in future years. In the present instance the Council are indebted to the Bristol and West of England branch and especially to its secretary, Mr. G. W. Brown for undertaking this work. The arrangements made by the Bristol and West of England branch are contained in what follow.

Programme

Visits will take place on Friday, October 7, when a large number of important foundries in the Bristol area have kindly agreed to receive parties of members. These firms have been divided into groups of two, and each group of visits will consist of one in the morning and one in the afternoon. Luncheon will be provided at some suitable place about mid-day. Members are asked to indicate on a reply form which group of visits they wish to attend and, as the number permitted to attend each group is strictly limited, their second and third choices.

Coaches leave from Anchor Road, Bristol, for visits "A," "B" and "C" at 9.30 a.m.; visit "D" 10.30 a.m., and visit "E" 9.15 a.m. (Anchor Road is situated near to the Tramways Centre and can be reached by way of Cannons Road).

In the evening, there will be a dinner and entertainment at the Grand Hotel, Bristol. The charge for each group of works visits, including transport by coach, luncheon, gratuities and administrative expenses is 21s., and the additional charge for the dinner in the evening is 21s. Members who desire to participate are requested to return the reply form to the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester 3, not later than Saturday, September 10—earlier if possible.

In order to provide accommodation for visitors from other branches, the Bristol and West of England branch has agreed to limit the number of its own members in each group. Bookings from all other members will be allocated strictly in the order in which they are received. Members participating are required to make their own arrangements for hotel accommodation, and are advised to book at the earliest possible moment (and in any case not later than August 31).

(Continued at foot of column 2)

TABLE I.—*Programme of Works to be Visited in the Bristol Area (by kind invitation of directors and managers of each company).*

Party.	Morning visit.	Luncheon.	Afternoon visit.
A	Westinghouse Brake & Signal Co., Ltd. (general engineering, cast iron and non-ferrous foundry)	Westinghouse Brake & Signal Co., Ltd.	Stothert & Pitt, Ltd. (dockside installations and general engineering; iron and copper-alloy founders).
B	Newman, Hender & Co., Ltd. (valves, cocks, steam and water fittings; iron and non-ferrous founders)	T. H. & J. Daniels, Ltd. ..	T. H. & J. Daniels, Ltd. (mechanical and hydraulic engineers; machine tools; iron and aluminium founders).
C	Newman, Hender & Co., Ltd. (valves, cocks, steam and water fittings; iron and non-ferrous founders)	Newman, Hender & Co., Ltd. ..	R. A. Lister & Co., Ltd. (agricultural electrical and general engineering; iron foundry).
D	National Smelting Co., Ltd. (zinc, sulphuric acid and cadmium manufacturers; zinc ingots and billets; zinc-base alloys)	National Smelting Co., Ltd. ..	Charles Hill & Sons, Ltd., and J. Jefferies & Sons, Ltd. (shipbuilders and repairers; general jobbing foundry).
E	Bristol Aeroplane Co., Ltd. (aircraft engines and accessories; light-alloy founders)	Grand Hotel, Bristol	Douglas (Kingswood), Ltd. (engines, motor cycles, electric vans; iron and aluminium founders—sand and die-cast).

Congress Paper Author

Mr. Hiram Brown, who is the Author of the official American Exchange Paper, "Evaluation of Casting Processes," printed on the facing page, received his early technical training at Fenn College, Cleveland, Ohio, graduating with a B.S. degree in metallurgy. After graduation, he spent four years at the Detroit plant of Alcoa as foundry metallurgist, following which he served for a similar period with the Frontier Bronze Corporation, Niagara Falls, New York, as chief metallurgist, and while in this latter position Mr. Brown perfected the aluminium alloy known as 40E. After spending 18 months with Aluminium Industries in Cincinnati as assistant works manager and later as works manager, he was appointed in 1946 to his present position of company chief metallurgist to the Solar Aircraft Company, Des Moines, Iowa. He is also a member of the corporate staff of this firm. Considered as one of the outstanding Americans in light metals metallurgy, Mr. Brown has done pioneer work in the field of high-temperature alloys, in addition to which he has had considerable experience in sand permanent moulds, die-, plaster- and investment-casting of light metals, copper-base and nickel-base alloys and sand and shell moulding of stainless steels. A member of the American Foundrymen's Society, American Society of Metals and American Society of Testing Materials, he is the author of the book "Aluminium and its Applications" and has also written numerous articles for technical publications. Well known as a speaker, Mr. Brown has lectured to numerous national and local technical and non-technical groups and at a number of American universities.

Latest Foundry Statistics

The Council of Ironfoundry Associations announces that employment in iron foundries during the week ending May 28 was 144,502. The corresponding earlier figures were April 30, 1955, 144,683, and May, 1954, 139,827. According to the Ministry of Supply, aluminium castings output during April was 7,260 tons, of which 1,789 tons were sand cast, 4,150 tons gravity-die, and 1,321 tons pressure-die-castings.

Evaluation of Casting Processes*

By Hiram Brown, B.S.

The object of the Paper is to point out the advantages of castings for many applications, and the advantages or limitations of the various foundry methods. These points are weighed against the fact that in far too many cases castings are fighting to survive. The reason for this is ascribed to a number of factors: (1) *Ignorance of casting design and desirability on the part of designers;* (2) *casting too often is used only as a substitute for another process instead of a component actually being designed for casting from the start;* (3) *poor quality of castings from many sources;* (4) *too much effort expended in taking business from some other type of casting rather than taking jobs away from competitive industries; and* (5) *stifling the interchange of foundry knowledge and failure to get maximum results from established casting methods.*

The situation is reviewed from the technical viewpoint of close association with foundrywork, and from that of actually having to recommend the use of castings, purchase them, and inspect them for conformity to high-quality standards. Since high-quality standards are here to stay, it is recommended that two steps be taken: (1) *Start engineers thinking about castings while they are in college, and* (2) *foundrymen must accept high-quality standards and make every effort to improve their casting processes to meet those standards rather than constantly complain that quality requirements are too severe.*

The consideration of the subject matter in this Paper will be approached from two widely divergent points of view:—(1) The first part will be a discussion of moulding methods from a technical point of view as seen by the Author as a result of the many years spent working in foundries of various types, and (2) the second part will be a discussion of castings as seen by the Author in recent years as a result of his experience in the specifying, procuring, and testing of castings for use in the jet- and gas-turbine industry.

PROPERTIES OF CASTINGS

In working with many engineers and designers the Author has frequently found them to harbour an amazing number of misconceptions concerning the properties of castings; in fact, it sometimes appears that many of them are completely uninformed about casting processes in general. For that reason, it may be well to discuss briefly the advantages of castings before discussing the merits of the various casting processes.

Castings have many properties which make them desirable for both structural and non-structural applications. They are not just a substitute to be used when parts fabricated by some other method are in short supply. In fact, there are many cases where casting can successfully replace other methods of fabrication strictly on the basis of merit. Because many of their good properties are not always understood by designers, castings are often regarded as inferior, and are often compared unfavourably with wrought products. All too often, this unfavourable comparison results from half truths, fallacious reasoning, or—more generally—ignorance of what castings have to offer. It should be emphatically stated that there are many advantages of castings which enable them successfully to compete with other fabricated forms for many uses when the facts are examined fairly, honestly and thoroughly.

Casting is the only process which has only slight limitation on size, shape, and intricacy. Parts which weigh either a fraction of an ounce or many tons are being cast. Because of the plastic nature of most moulding materials, moulds can be shaped to almost any desired configuration. Due to the fluidity of molten metal it can be made to reach even remote corners in order to fill previously determined contours.

In many cases, parts can be cast to size and shape, with a surface finish that requires no machining, and close tolerances can be held. In cases where the extremely fine finish required can be obtained only by machining, castings can minimize machining, since the essential shape desired can be cast and only finish, clean-up, cuts need to be taken. For example, Figs. 1 and 2 show typical centrifugal stainless-steel castings which are meeting aircraft X-ray quality standards, and which require a minimum of machining to make the final part. This contrasts sharply with parts which must be hogged out of bar stock, or forgings which do not even approximate the final shape desired. There are some very hard and tough alloys which are extremely difficult to machine; in many cases these can be cast close enough to size and shape that only grinding is required to bring the parts within tolerance.

Other Advantages

One factor often discussed is the relative strength of castings *versus* wrought material—a story which is often distorted— and it seems advisable to make a definite statement about this. The mechanical properties of cast and wrought material having the

* Official Exchange Paper from the American Foundrymen's Society, presented at the Fifty-second Annual Meeting of the Institute of British Foundrymen, last June. The Author is chief metallurgist, Solar Aircraft Company, Des Moines, Iowa.

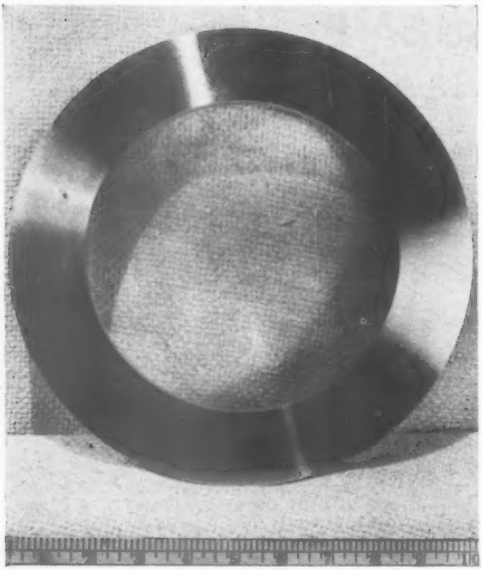


FIG. 1.—*Machined stainless-steel centrifugal casting —very close to finished dimensions in the as-cast condition.*

same composition and heat-treatment are usually quite similar. This statement appears to be contradictory in view of the higher properties usually quoted for wrought alloys. However, those high properties given for wrought material usually represent tests taken in the direction of working. These will normally be higher than cast properties; however, properties of wrought parts tested in the transverse direction will be lower than those of castings. This points out one definite advantage of castings, and that is their uniform, non-directional properties. Test results of specimens taken from a casting should be in close agreement regardless of the direction in which samples are taken.

Another important advantage of castings is their dimensional stability. In machining many wrought parts, it is found that they will warp or distort out of shape. During rolling or forging the metal grains are distorted out of shape and hardening results, then, the strained grains are held in an unnatural position and shape and are trying to return to their natural state. When some of the stressed area is removed by machining, the remaining stresses attempt to redistribute themselves and distortion and warpage takes place. Furthermore, if wrought parts are heated to remove stresses, severe distortion and warpage can occur. Re-shaping after stress relief may be necessary, and this is often difficult to accomplish. On the other hand, casting grains, because of the way they are allowed to crystallize in a natural pattern with a minimum of restraint, tend to be equiaxed and relatively free from residual stress so that dimensions are much more stable during machining or heating.

Grain Size

Castings are also noted for the stability of grain size. The grain size of most cast metals—provided they have not been plastically deformed by working —cannot be changed below the melting point. (The only exceptions to this are alloys, such as steel—which undergo an allotropic change which is accompanied by a complete change in crystal structure with the formation of new grains.) This is true no matter what the grain size is in the cast metal, but is not true of wrought materials, since grain growth can occur at relatively low temperatures. Normally, stress-free metal grains are so shaped that, on the average, their diameters are equal in all directions (equiaxed). If metal is deformed when cold, the grains are similarly deformed. When such deformed grains are heated, a temperature is reached where re-crystallization will take place and the broken and distorted grains will assume an equiaxed shape. This temperature will be lower the greater the amount of cold work and the smaller the grain size before working. As the temperature increases above this re-crystallization temperature, grain growth can occur—small grains may join to form larger ones and larger grains may absorb smaller ones. This grain growth may go on through several heating cycles until a very large grain-size results. In a similar way, hot-working will break up grains into smaller grains, and when such material is subsequently heated there will be fewer and larger grains.

This wide disparity of grain gradients does not exist in castings. With few exceptions, as mentioned earlier, cast alloys will undergo no change in grain size at any temperature below the solidus line. Even in the case of the few exceptions, the temperature for re-crystallization and grain growth of wrought alloys is much lower than the temperature of the transformation heat-treatment that would be necessary to cause a change in the grain size of a casting of a similar alloy. Castings do, therefore, have a much more stable grain-structure and are not so likely to undergo grain growth. This is an important factor where in-process stress-relief treatments are necessary during fabrication of assemblies.

Design

Because castings are practically unlimited by size or shape, a casting can be designed very close to engineering requirements, so that metal can be placed at the desired location, thus making it possible to obtain better strength : weight ratio. This is not true of processes which are limited in regard to size and shape and where design must be based on fabricating requirements rather than on the optimum strength : weight ratio.

With these many advantages in their favour, it would seem there would be a clamour for castings for structural uses. Unfortunately, this is too often not the case for reasons which will be discussed later in this Paper.

Evolution of Processes

It is interesting to theorize whether sand or die-casting was the first to be used. There is evidence which gives credence to the idea that at a very

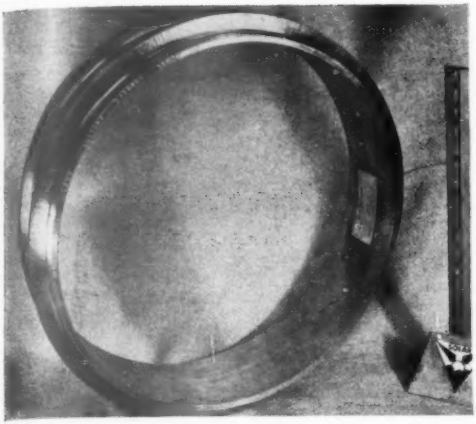


FIG. 2.—*Second example of a machined stainless-steel component, cast centrifugally very close to finished dimensions.*

early date metal shapes were cast in stone moulds; those moulds probably represented the first type of permanent moulds. It is certainly not hard to visualize that prior to this time simple shapes had been cast by scooping holes in sand or clay in the ground and pouring metal into them. Since shape and utility rather than high quality was the determining factor, proper gating and pouring techniques probably received little consideration. Many people to-day have the opinion that the foundry business has changed very little since that time; however, foundrymen themselves know that there have been tremendous strides made in recent years. Nowhere is this so typified as in the parade of "precision-casting methods."

As far back as most can remember, the term "precision casting" has been applied to some form of casting. It was probably first coined thousands of years ago when some man found that he could cast better replicas from a shape carved in stone than by pouring metal into a hole in the ground. It was probably revived when the Chinese found they could cast rings on to bronze pots by the use of the "lost wax" process.

Of course, few can remember that far back, but most can recall the modern counterpart of this history. Instead of a hole in the ground foundrymen found that a shape made in a mass of sand could be easily and cheaply prepared and filled with molten metal to form cast-metal parts. Then someone found that shapes carved into metal moulds offered certain advantages. The use of the word "precision" came into common usage in comparing those "die-castings" with sand castings.

After that, pressure-die-castings usurped the role of "precision" castings; then came plaster and investment "precision" castings, and now there is "shell moulding" as the newest member of this family. In each case, as the new process made its appearance, it was accompanied by a colourful promotion programme inevitably accompanied by some overselling; some companies even use the word "precision" in their title. Eventually each type of casting process has settled into its proper place. Is shell moulding going through that same phase to-day?

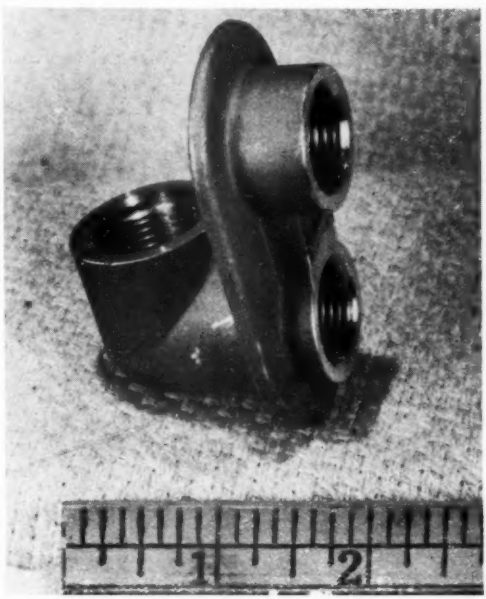
What is Precision?

Let it first be established what the word "precision" means. Precision is defined as accuracy, which in turn is defined as "exact conformity with truth *or with some standard.*" These last four words seem to indicate that precision is a relative word whose actual meaning varies with the stand- and used to judge it.

What are the factors involved in selecting a casting or the process for producing it? First, is extreme accuracy necessary for the part involved? Will the casting be machined? If so, will a few thousandths more of metal actually be more difficult or costly to remove? Since any "precision" part will demand a premium payment, is the accuracy obtained worth additional cost?

What about the basic strength of the parts?—can strength be sacrificed for greater accuracy? For example, gravity-, and pressure-die-castings will be stronger than shell-moulded castings of similar design and section size. Generally, sand castings will be stronger and more sound than investment castings.

FIG. 3.—*Stainless-steel investment castings of this sort had gross shrinkage and entrapped gas. The component was cast solid and the holes tapped afterwards.*



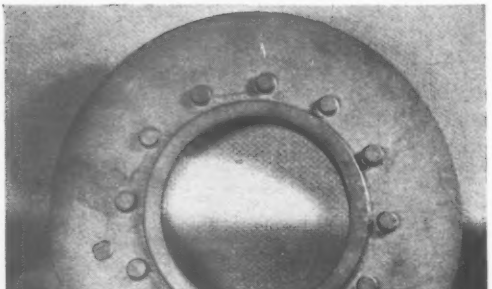


FIG. 4.—*Grade* 310, *stainless-steel investment castings of this design had extremely large grain-size.*

What about size?—There are definite limitations to the size of parts which can be produced by the various processes. At present, sand casting is the only process which is practically unlimited in size of parts produced.

How about shapes; cored holes or undercuts?—These may limit the process which can be used or the tolerances obtainable.

Critical Self-Examination

Finally, what are the latest advances in techniques in the various fields of casting? Sand castings should not be sold short as precision parts. Foundries now extensively make use of dry-sand moulds, skin-dried moulds, and new high-strength "green" sands. The fact should not be overlooked that a number of small parts can be rapidly and accurately produced in sand foundries by use of a matchplate pattern, whereas those parts could be made only singly or a few at a time by some of the other processes.

Examine all the methods; check all the factors. Is not precision relative? Then why should there not be precision sand castings as well as precision investment castings? Designers and foundrymen might well avoid the phrase "precision casting" unless it is accompanied by the name of the casting process. Where satisfactory tolerances may be obtained by several casting methods, the phrase "close-dimension castings" is put forward.

Limitations and Shortcomings

In reviewing this list of "precision-casting methods," it would appear that Utopia for users of castings was just around the corner. Unfortunately, when one is in the position of designing castings into structural aircraft applications, purchasing such castings, or inspecting them, one finds the picture quite different. It is soon discovered that most of those who write about these processes have told the truth, but not the whole truth. Since most of them have something to sell, they do not warn of the limitations or shortcomings of the various processes. Thus, it is found that in many cases, because of process limitations and/or ignorance or carelessness on the part of many foundries, castings are literally fighting for their life. There are many engineers who will not permit the use of castings for structural parts. In fact, although the Author was a foundryman for many years, he is finding it increasingly difficult to defend castings in far too many cases.

What is there that causes this condition? Why are castings the only raw products which are normally required to be subjected to 100 per cent. X-ray inspection before structural usage? Are these fears groundless, or is there some reason for them?

Pressure-die-castings

Let us examine the various recent "precision casting" methods. Since gravity-die-casting has matured and come-of-age technically, that method is being excluded from this discussion, and a start will be made with pressure-die-castings. One can obtain pressure-die-castings which have good tolerances and finish, but allowance must be made for intricate parts; as-cast strength is good in the unmachined state, but may be considerably less after machining. Due to the presence of porosity, unless very high pressures be used, full strength cannot be developed by heat-treatment and the end use must be based on as-cast properties. Usually $\frac{1}{2}$ in. is the maximum practical thickness limit, tooling and equipment costs are high, and also cost per part for small runs. This makes the use of the process limited for jet-aircraft work, for example, where quantities are never astronomical and design changes are so frequent that every effort is made to minimize tool and die costs.

Investment Casting

The investment-casting process made its entry into the field with unprecedented publicity. It was regarded as a panacea; astonishing tolerances and finishes were claimed.

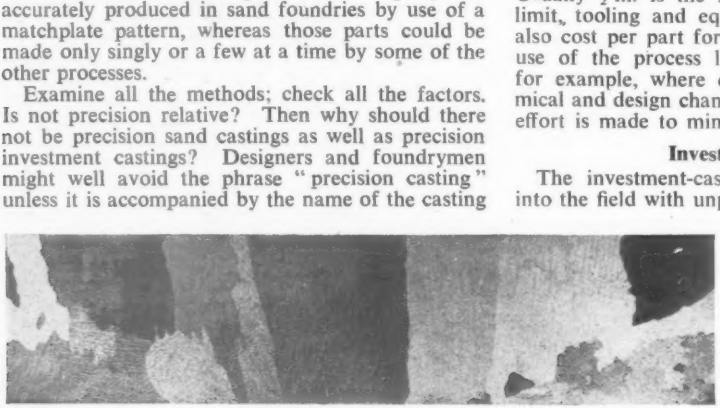


FIG. 5.—*Grain size of a casting shown in Fig.* 4, *etched in chrome/regia,* ×5.

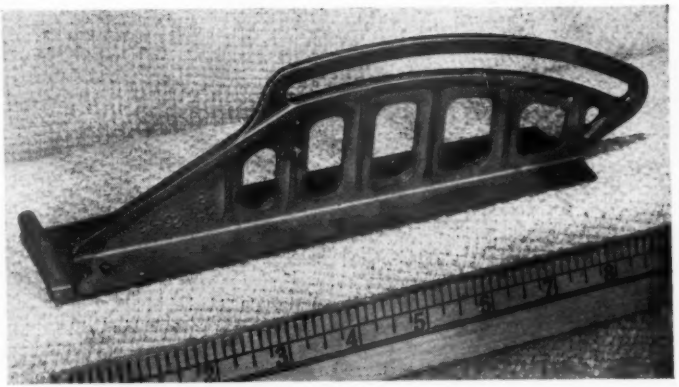


FIG. 6.—*Complicated austenitic stainless-steel investment casting in satisfactory production by one large, well-established producer.*

Many purchasers were "burned" before the myth was deflated. Tolerances of a few thousandths inches rapidly became ±0.010 in. and more, depending on size and shape. It can truthfully be said that, in general, personal experiences in buying investment castings have not been good; casting quality has been very poor. If the castings have been made under radiographic control—as called for in the specifications—then blind film readers must have been used. The Author has received many simple parts such as that shown in Fig. 3 which contained large areas of gross shrinkage or entrapped gas. It is not an uncommon practice for X-ray men working with investment castings to use lead screens in the head of the X-ray machine to overcome the mottling effect due to very large grain-size. Unfortunately, however, this also tends to hide other defects or to reduce the sharpness of contrast and detail so that if defects are visible they do not appear to be gross. Whenever such parts are X-rayed without lead screens in the head —as is personal practice—the defects are readily visible, and much discussion of results promptly ensues.

Large grain is common, but the Author has received some Grade 310 stainless-steel parts such as those shown in Fig. 4, which had extremely large grains, sometimes one grain per cross section as shown in Fig. 5. These are undesirable for several reasons: (*a*) Bend tests made on sections taken from such castings of 310 stainless steel were quite erratic. Some bent through 180 deg. satisfactorily, others cracked along grain boundaries, with bends as small as 90 degs., and others showed severe neckdown at the centre of the bend indicating that elongation was extremely localized. (*b*) In many cases after machining, zyglo tests showed seepage at the grain boundaries and X-rays showed indications of minute cracks. (*c*) Large grains exhibit a tendency toward hot-shortness and are likely to crack during casting or welding. (*d*) Many high-temperature alloys with coarse grain-size show marked decrease in ductility at elevated temperatures and may actually tend to be hot-short in the engine-operating range[1].

Importance of Casting Technique

Investment-cast tensile-specimens in many cases show lower strength than similar sand-cast specimens. Some good, well-established investment founders can produce satisfactory castings of very complicated shape and size such as that shown in Fig. 6. However, it would appear that most investment foundries cast to obtain a given shape only, with little thought being given to proper gating or venting. The recent work of General Motors Research[2] shows how much improvement in properties can be made by changing the gating and supplying adequate vents. Yet despite these findings, many investment foundries seldom use vents, with the result that simple castings such as those shown in Fig. 7 often contain large areas where only a thin metal skin covers holes resulting from entrapped gas.

There is a tendency to regard investment casting as a casting method completely apart from other foundry methods; many people with no previous foundry experience seem to think this sort of casting is simple to do. Effort is made to achieve eco-

FIG. 7.—*Simple austenitic stainless-steel investment casting containing large internal holes, resulting from entrapped gas.*

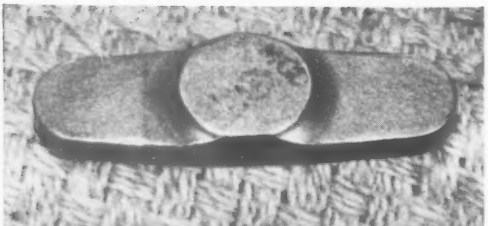


FIG. 8.—*Investment-cast austenitic stainless-steel casting re-designed as a machined part due to inability of castings to meet X-ray requirements for soundness.*

nomy by loading as many parts into a mould as possible and using small gates and risers. Although other types of foundries have found it necessary to de-gas many alloys—especially in humid weather—most investment casters believe they can get along without this bother, or at least they simply omit the de-gassing operation. As a result, all the foundry techniques learned by other industries through many years of experience tend to be ignored—and too often the results are horrible to contemplate. In fact, a personal approach is never to order a part to be investment cast if it can be obtained in any other way without unreasonable cost. Fig. 8 shows a fairly simple investment-casting which for months did not meet X-ray requirements (because of excessive shrinkage) and the Author finally recommended a design change permitting him to machine the part from bar stock.

Shell-moulding

Shell-mould casting next made its advent with a fanfare. Operators of the process fell into many of the pitfalls of investment casters. The process was oversold, and many expected miracles did not materialize. In most cases, casting finish has not been as good as expected, and in many cases is very bad. In some non-ferrous alloys it was found that high pouring-temperatures resulted in rough or prickly surface. Low pressure-head tended to improve casting finish.[3] There is some indication that this is also true with austenitic high-temperature alloys. Also, tolerances have been widened, particularly where the parting line is involved or where parts are large, and bulging of a shell can occur. Large automatic mould-making equipment has proved to be less than sensational.

Where very close tolerances are promised in shell moulds, it becomes very difficult to get patterns which will give the accuracy desired. Furthermore, a single piece of sand falling into the mould can ruin surface finish in a localized area where no pits are permitted—a requirement which does exist in some of the food and dairy applications for castings. The cost of the binder makes the process rather expensive. The binder, also, in many cases causes a surface pick-up of carbon by steels and where this is undesirable—as in austenitic high-temperature alloys—a diffusion heat-treatment is necessary.

Other Snags

Grain size is often very coarse and, although not as bad as that encountered in investment castings, does show severe mottling on X-ray examination and a very diverse grain-size when many castings are sectioned and examined macroscopically. The coarse-grain condition is accentuated by superheating and high pouring-temperatures, which are, in many cases, a substitute for good gating-practice in helping the metal to flow into the mould. Typical shell-cast parts having mixed grain structure are shown in Figs. 9 and 10, and a typical microstructure in Fig. 11.

There have been reports of difficulty in casting low-alloy steels in shell moulds, and so far there seem to be very few occasions where the process is needed for the light metals. In almost all cases light-metal parts can be cast in sand moulds—with special facings, etc.—with results equalling or surpassing those from shell moulds.

It was believed that, because of the thin wall of the shell moulds, fine grain would be obtained by rapid heat-dissipation and that use of zirconia "sand" or backing up with shot would help promote fine grain-size. Unfortunately, this was too much of an assumption and has not always worked as hoped. The best example of this is the austenitic stainless-steels (containing Cr and Ni). These alloys have very low thermal conductivity and as any kind of chill—mould or insert—cannot conduct heat away any faster than the base metal will give it up, and since these austenitic steels transfer heat very slowly, it is almost impossible to refine the grain by chilling. Thus it has been found that for such metals neither zirconia nor shot back-up appreciably improves the cooling rate over that obtained in silica-sand shell moulds.

Conclusions

From the foregoing observations several conclusions are drawn:—

(1) New processes are usually oversold and someone gets "burned." It is common to point out to prospective customers the number of parts actually being cast by the new process; however, it should be kept in mind that many of these are being cast only because of the novelty of the process. Someone reads or hears about the process and decides to give it a try. It is, therefore, difficult to evaluate properly a process early in its history. Many special applications will be suited by the process, but more standard items must await the test of time.

(2) New processes are misused by engineers, who are intrigued by anything new or novel. Thus many parts which will be—or could be—machined

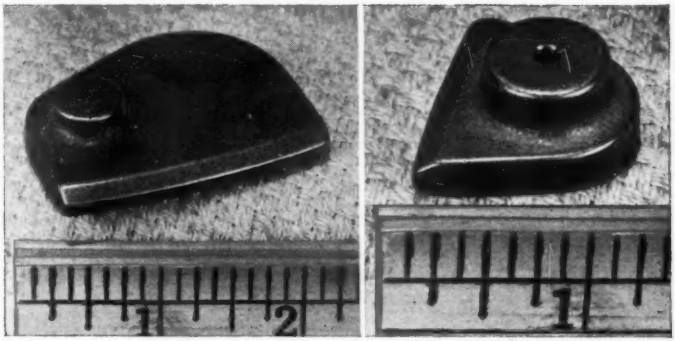


FIG. 9.—*(left) Typical shell-cast austenitic stainless-steel casting which had mixed grain structure, and,* FIG. 10, *shell-cast austenitic stainless-steel casting having a mixture of very large and small grains at the junction of the heavy boss and thinner base section.*

economically are cast in investment or shell moulds. The part is costly because those processes strive to produce good tolerance and finish. If these qualities are not needed, why demand them or pay the price required?

(3) Many very great improvements could be made in sand or gravity-die-castings if as much time was devoted to them as is devoted to the "new" processes. The Author wonders what the answer would be if each foundryman gave some time to asking himself, "Am I getting all I can out of my present casting process?" The resultant improvements might cut deeply into the "new" processes. Perhaps the new D (Dietert) process[4] or high-pressure moulding may be steps in this direction, since both are essentially adaptations of old-established, standard moulding methods.

Some sand foundrymen are just beginning to learn that the mould material is just as important as the metal itself; there are good and bad sands, and just any sand won't do. There are other mould materials such as zirconia and olivine which merit investigation. Electromagnetic pumping of some metals into die-casting moulds can mechanize this process as it progresses further from the state of being an art to the state of being a science. The gating research work sponsored by the American Foundrymen's Society and performed by Battelle Memorial Institute has pointed the way to improved pouring and gating techniques for the horizontal-type gating, such as that normally used in sand casting. Work is now in progress to explore the same techniques in relation to the vertical gating, frequently used in die-casting, shell, and investment casting.

(4) Devotees of the various casting methods spend far too much time fighting each other, and in closely guarding so-called "trade secrets" and refusing to discuss them with others. This keeps out far more knowledge than it keeps in. As long as efforts are made to maintain the tradition that many casting methods are an art rather than a science, optimum business will not be attained but, instead potential customers will be alienated. Perhaps the previously mentioned research on vertical-gating systems will break down some of these barriers and give a good boost to the entire foundry industry, since the results will be freely publicized and not kept under cover.

(5) It would be far better for the casting industry if all foundrymen would pool their knowledge, help each other, and—instead of stealing business from each other—increase the overall market for castings by taking jobs away from competitive industries. The time to start this is before the designer gets his prints drawn up. A casting is most successful when it is designed as a casting and not as a substitute for a forging or a welded section. This calls for two aggressive actions:

(*a*) Time should be spent in educating engineers concerning the merits of castings. This should not only include men in industry, but should extend into college curricula.

(*b*) When castings are specified, more time and energy should be applied to make them of

FIG. 11.—*Photomicrograph of a shell-cast part such as is shown in* FIGS. 9 *and* 10; *etched in chrome/regia;* ×6.

Evaluation of Casting Processes

good quality, and less time in complaining about high-quality standards and requesting downgrading of those standards.

High quality standards are here to stay—how about casting? The answer to that rests with the foundrymen.

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[2] D. G. McCullough and R. F. Thomson, "Technique for Improving Quality of Investment Castings," A.F.S. Preprint No. **54-37**, Cleveland, Ohio, May, 1954.
[3] S. S. Brown and H. K. Worner, "Shell-moulding Copper-base Alloys," A.F.S. Preprint No. **54-79**, Cleveland, Ohio, May, 1954.
[4] Harry W. Dietert, "D Process for Precision Castings," *American Foundryman*, August, 1954, **26** (No. 2), 56–65.

British and World Shipbuilding

Steamships and motorships under construction in Great Britain and Northern Ireland at the end of June totalled 338 ships of 2,081,534 tons gross; a decrease of 62,612 tons compared with 335 ships of 2,144,146 tons in the previous quarter, states Lloyd's Register shipbuilding returns for the quarter ended June 30 relating to merchant ships of 100 tons gross and upwards. The vessels included 114 steamships of 1,227,638 tons, and 224 motorships of 853,896 tons. In other British Commonwealth countries there were under construction, 12 steamers of 19,604 tons and 37 motorships of 93,574 tons. Oil tankers building in Great Britain and Northern Ireland in the June quarter totalled 80 ships of 1,011,081 tons, a decrease of 93,287 tons compared with the previous quarter. Vessels building in the world numbered 1,349 of 6,100,534 tons compared with 1,276 of 5,963,187 tons, including 8 wooden ships of 1,005 tons. The total included 294 steamers of 2,873,903 tons and 1,047 motorships of 3,225,626 tons. Construction in hand in the principal districts of Great Britain and Northern Ireland is indicated in Table I.

The sizes of steamships and motorships under construction in Great Britain and Northern Ireland included the following:—100 to 1,000 tons, 15 steam (102 motor); 1,000 to 2,000 tons, 4 steam (18); 2,000 to 4,000 tons, 14 steam (16); 4,000 to 6,000 tons, 6 steam (16); 6,000 to 8,000 tons, 10 steam (24); 8,000 to 10,000 tons, 10 steam (26); 10,000 to 15,000 tons, 20 steam (19); 15,000 to 20,000 tons, 10 steam (3); 20,000 to 25,000 tons, 21 steam (nil); 25,000 to 30,000 tons, 2 steam (nil); 30,000 tons and above, 2 steam (nil).

TABLE I.—*Vessels under Construction in Principal Districts of Great Britain and Northern Ireland.*

District.	June 30, 1955.		March 31, 1955.		June 30, 1954.	
	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.
Aberdeen ..	22	24,567	17	27,455	20	25,652
Barrow ..	4	86,000	5	107,140	6	116,120
Belfast ..	18	223,690	17	211,250	17	222,880
Bristol ..	4	2,030	4	2,070	5	3,640
Clyde—						
Glasgow ..	75	443,224	72	465,684	84	549,571
Greenock ..	32	216,732	33	215,710	31	197,320
Dundee ..	6	35,110	6	34,610	6	37,850
Hartlepool ..	7	42,894	7	39,884	8	51,074
Hull	33	18,214	31	16,618	27	13,633
Leith	16	57,990	15	49,560	10	38,420
Liverpool ..	19	153,462	20	150,768	14	134,313
Middlesbrough	12	168,523	15	197,050	17	218,460
Newcastle-on-Tyne ..	37	391,570	39	399,330	40	382,809
Southampton	3	1,734	4	2,084	4	6,154
Sunderland ..	28	202,760	27	212,790	26	191,095

Steel Production Prospects

When the Iron and Steel Board announced that the reduced rate of steel output in June could be attributed to the effects of the rail and dock strikes, it stated that it was estimated that the strikes were responsible immediately for the loss of about 150,000 tons of steel and 120,000 tons of pig-iron and that the full adverse effects of the labour disputes might not be seen for some time. Nevertheless, the board believes that there still remains a prospect of producing about 19,500,000 ingot tons of steel this year, compared with just over 18,500,000 tons in 1954.

In its annual report the Iron and Steel Board drew attention to the difficulties arising from the strain on shipping and unloading facilities in carrying through the heavy programme for the import of the necessary raw material in 1955. It had been hoped that these would lessen during the summer, but they had, in fact, been intensified by the continued import of coal, by other abnormal movements of commodities throughout the world, and by the dislocation of shipping programmes by the rail and dock strikes.

The consequent curtailment of iron-ore imports during the peak summer period may well involve some check in the expansion of pig-iron output next winter expected from the operation of four additional blast furnaces in the second half of this year. These furnaces have an estimated extra output of 1,000,000 tons of pig-iron a year. They are two new large-capacity furnaces at Shotton and Margam, respectively, and facilities for three-furnace operation at Ebbw Vale and at Barrow.

Finished-steel Deliveries

The Iron and Steel Board says that this check in the expansion of pig-iron output may result in steel output during the latter part of this year and the early part of next year being rather less than was at one time thought probable.

Deliveries of finished steel to UK users for the first five months of the year compared with the corresponding period of 1954 were:—

Month.	1954.	1955.	Increase.
	Tons.	Tons.	Per cent.
January	972,000	1,017,000	5
February	996,000	1,064,000	7
March	1,243,000	1,352,000	9
April	939,000	1,048,000	12
May	983,000	1,110,000	13

The increased deliveries to home users has arisen in part from the expansion of steel production shown in the table above and in part from an increase in imports, the Iron and Steel Board states.

Exports of steel rose from an average of 40,000 tons a week in the first five months of 1954 to 52,000 tons a week in the corresponding period of 1955.

Details of deliveries to home consumers for the month of June are not yet available. Owing to the strike difficulties they are unlikely to show a significant increase over the previous year, but the board says there is a good prospect of steel deliveries in the second half of 1955 continuing at about 10 per cent. above deliveries in the second half of 1954.

Stocks of steel held by producers are approximately 1,000,000 tons. This is slightly over the level at the beginning of the year. The census of stocks held by consumers and stockholding merchants at the middle of the year is now being taken and it is not yet known whether the stocks of 3,100,000 tons held by them at the beginning of the year have materially changed.

Publications Received

Better Ways; published by the British Productivity Council, 21, Tothill Street, London, S.W.1. Price 2s. 6d. post free.

This is a collection of articles which have been printed in recent times in *Target*, but they have been assembled in such an orderly fashion that a continuous story has been constructed, starting from work-study and terminating in staff selection—a matter of 19 chapters. In every case, except one, each chapter finishes with a case study. Two of these are taken from the foundry industry, the first being the outstanding change made in John Harper & Company's fettling shop after the conclusion of a time study and the installation of new machinery. The second is used in connection with "Layout and Handling," and here the case study is that of the Imperial Foundry Company, Leamington. There is a wealth of illustration and a perusal of the information detailed will draw attention—no doubt—to some section of one's works which requires modernization.

Methods in the Detection of Toxic Gases in Industry, No. 7. "Carbon Monoxide." Published by HM Stationery Office, York House, Kingsway, London, W.C.2. Price 10½d. post free.

The leaflet describes the places where the gas is likely to be present and the ways in which dangerous concentrations can arise. As the gas is colourless and odourless, it can be most insidious and concentrations as low as 100 p.p.m. can cause mild symptoms of poisoning to anyone continuously exposed to them. Canister respirators, including civilian and service types, are not effective against carbon monoxide.

Also described is the method of detection, the use of indicator tubes and the safety precautions to be used when making the tests. It is emphasised that if an operator has to enter a confined space to make a test he should wear either a breathing apparatus with self-contained oxygen supply or one supplied with fresh air from an uncontaminated source.

Williams Alexandra Foundry Limited, 1905-1955.

This company is to be congratulated on the attainment of its 50th anniversary. Moreover, it is pleasing to announce that its founder, Mr. William Williams, is still at the helm. The brochure describing this history has been extremely well written and is splendidly illustrated. Mr. Williams started with a capital of £14, but he still needed to buy metal for making the castings and £10 was borrowed, but before it could be used it was stolen and another £10 had to be found. The brochure tells how, taking advantage of the changing nature of demands, the firm has grown to a business with a turnover of about £1,000,000. One particularly successful business which they now operate, was never very profitable until it was acquired by Mr. Williams. The story of this concern is what is known as a success story, due to a proper appreciation of ever-changing demands.

Vacuum-blast Cleaning. A four-page pamphlet received from Vacu-Blast, Limited, 291, Aberdeen Avenue, Slough, describes the "medium" model machine. It is larger than "junior" which was illustrated and described in the JOURNAL, February 24. The new pamphlet is available to readers on writing to Slough.

House Organs

Iron Worker, vol. 19, No. 2. Published by the Lynchburg Foundry Company, Lynchburg, Va., USA.

No foundry concern, anywhere, has a more acute sense of the value of local history and its real interest to the modern reader than the Lynchburg Foundry Company. A lengthy acquaintance with this magazine has convinced the reviewer, rightly or wrongly, that this part of Virginia was the cradle of American history. It is not only the district history that comes in for consideration, as this issue contains an account by Mr. G. H. Nowlan, Jr., of the high-grade metallurgical control established in the works in the early 1900's, which included metallographic studies. Photomicrographs were used, which were at that time quite rare, even in Sheffield. This the reviewer finds is extremely interesting and a real compliment to the old-time metallurgists.

Stantonian, vol. 19, No. 6, April, 1955. Issued by the Stanton Ironworks Company, Limited, near Nottingham.

This issue is both colourful and interesting, the "colour" being supplied by the front and back covers and an inset map of the Stanton estate. The major interest (to the non-Stantonian) is a well-illustrated description of various antiquities to be found on this estate, such as abbey ruins, windmill, and the blacksmith's shop.

Broomwade News Bulletin, vol. 18, No. 3; issued by Broom & Wade, Limited, High Wycombe.

This is particularly interesting as it gives details of the performance of the Cutty Sark. Its 30,000 sq. ft. of sail, at 16½ knots, developed the equivalent of 4,000 h.p. Then there is a note as to the use of non-spark tools in explosive surroundings. These tools are made for Broom & Wade by a Cheltenham foundry.

Foseco Foundry Practice No. 120, issued by Foundry Services Limited, Long Acre, Nechells, Birmingham, 7.

Especially good in this issue are coreshop hints, wherein sound practice is covered by short paragraphs illustrated by pin-men sketches. There is also a good article on "Metal/Mould Reaction."

Newsletter. Issued by the David Brown Organization, May, 1955.

In this Newsletter there is an excellent article on the background organization of Bertram Mills' circus, which utilizes a number of David Brown tractors for handling the caravans and lorries to and from the railways.

Aero Research Technical Notes, Bulletin 148. Issued by Aero Research Limited, Duxford, Cambridge.

This issue recalls that, by a happy chance, the 21st anniversary of the company coincided with the visit to the works by HRH The Duke of Edinburgh. A full illustrated description is given of this outstanding event.

Internal Transport. J. Collis & Sons Limited, Regent Square, Gray's Inn Road, London, W.C.1, in list No. 300, illustrate and describe hydraulically operated trucks. There is quite a wide range available and their characteristics are well set out in this most attractive 12-page brochure It is available to those readers who write to Gray's Inn Road.

Law Cases

Absence of Goggles Blamed

A 49-year-old Hadley (Salop) foundry bogey runner, William Bowen had his clothes set on fire and his eye damaged when there was an explosion at his work at Ketley in August, 1952, it was stated in a civil action at Salop Assizes recently, when the man claimed damages from Aga Heat Company, Limited.

For the plaintiff, Mr. Norman Carr alleged negligence either by the firm or by a servant of the firm. He said that Bowen was skimming slag from the top of molten metal in a bogey. He did this with a metal skimmer and it was essential that the skimmer should be dry. The application of water or moisture to molten metal would cause an explosion. Bowen had dried his skimmer about 20 min. prior to using it. He had put it in a girder recess where it was always hung when not in use. When he started to skim the molten metal there was an explosion. Plaintiff's clothes were set on fire and a piece of molten metal got in his eye, which was not completely destroyed but was severely damaged.

Mr. Carr alleged that somebody, who must have been a servant of the firm, must have splashed the skimmer with water or tea. The girder where the skimmer was kept was close to a water tap and although there was a door between the tap and the girder, it was a common thing for workmen to splash water or tea about. Mr. Carr submitted that it was unsafe for the firm to allow the tap to be near the skimmer and said that they should have provided goggles to protect the plaintiff, although there were no statutory regulations enforcing the use of goggles.* Mr. Carr added that special damages had been agreed at £228 1s. 8d., and both parties had agreed to the medical report.

In evidence Bowen said his eyes now became very misty and he had used glasses since the accident; he had pains over the eye. When the skimmer touched the molten metal it exploded and set some of his clothes on fire and a piece of metal went into his eye. He said that workmen after having a drink of water, often threw the rest away and he had seen tea leaves thrown on the girder.

Questioned by Mr. John Garrard, for the respondents, Bowen agreed that it was the first time he had done skimming that morning when the explosion occurred. He had previously heated the skimmer. He did not agree that he had applied the skimmer in the wrong way.

Mr. D. T. Turner, consulting engineer, said the use of goggles in similar places to this foundry was not uncommon in 1952. If the skimmer was stone cold when applied to the molten metal there would be a spluttering, but not to the same extent as if there was water on the skimmer. He agreed with Mr. Garrard that less than 50 per cent. of the firms supplied goggles in 1952.

Mr. C. Coop, works manager of the Aga Heat Company, Limited, said that when cold metal came into contact with molten metal there was a definite splash, but it was worse when water came into contact with the molten metal. He would expect any man with experience in a foundry to know these facts and he had no doubt that Bowen and other workers in the factory knew them. If the skimmer had been heated properly and water had splashed on it, the water would have evaporated immediately. This was the first time he had heard of anyone being injured in the eye with molten metal as the result of skimming. When he made an inspection aften the explosion he could find no moisture or tea on the girder or the skimmer.

Mr. Garrard submitted that the accident happened because Bowen heated the skimmer half-an-hour before he was going to use it and that it was cold when he did use it. Knowing that the skimmer should be heated before being applied to the molten metal, no one could be expected to know that the splashing of water on the skimmer or girder would provide danger.

Giving judgment for respondents, Mr. Justice Stable said he did not think there was a duty in 1952 to provide goggles. He thought there was no negligence by the firm, in having a water tap where it was in 1952, because there was a door between that tap and the girder where the skimmer was kept. He had also come to the conclusion that the splashing of water by workmen did not amount to actionable wrong. It would not have occurred to anyone that splashing water against this girder would provide a serious danger to anyone. Bowen had agreed that as an experienced bogey runner he had to make sure before he used his skimmer that it was dry. and warm. One could not blame Mr. Bowen who had dried the skimmer 20 min. before using it and one could not attribute very serious blame to him because when he started this work he more or less took it as read and did not make certain that the skimmer was warm and dry. The Judge said he thought it was wet and that was how this explosion took place. How could they hold his employers responsible, he asked?

Mr. Garrard said he understood this was a union case and in view of that he would ask for costs.

The Judge said that had he given judgment for plaintiff, he would have awarded him £500 general damages. Mr. Bowen was not apprehensive as to the future. There was no question of deterioration of his eyesight. In answer to Mr. Carr, Mr. Justice Stable said there was contributory negligence by plaintiff because he did not examine his skimmer before he actually started the job and he thought that was an oversight which amounted to negligence on his part.

*At the time af the accident, in 1952 — Editor.

Scrap Metal Fraud

At Derbyshire Quarter Sessions on July 6, a scrap-metal dealer, Norman Henderson, was sent to prison for 18 months, while his driver, William Horton, was fined £20, with an alternative of six months imprisonment. Both men pleaded "guilty" to obtaining cheques by false pretences and conspiring to defraud Marple and Gillott, Limited, iron and steel works, Sheffield, between September last year and January this year.

Mr. Brian Bush, prosecuting, said that the Sheffield firm employed Henderson to buy scrap and deliver it to Stanton Ironworks, Limited, near Nottingham. This was done but after the delivery lorry and its load had been weighed at the ironworks, it returned to the scrapyard at Bulwell, had some of the scrap removed, and then went back for unloading at the ironworks. In some cases, when the lorry returned to the yard before unloading at Stanton, lighter scrap replaced that taken off the vehicle and on some occasions the whole load meant for Stanton was replaced. The true amount of the fraud was impossible to assess, because no-one had been able to check the amount of scrap taken back to the yard, but in three cases there were discrepancies of £84 and twice of £43.

TESTS ON COAL from the nearby Mabou fields will largely determine whether Krupp's, the German steel concern, will establish a $60,000,000 (£21,900,000) plant near Canso, Nova Scotia.

Costing of Gravity-die-castings : Approach to the Problem in a Small Non-ferrous Foundry

By G. R. Cowley, A.C.A.

Costing is a technique giving information supplementary to that which is normally obtainable from financial accounts. How the technique is applied in any one industry will depend first on the complexity of that industry, and secondly on the amount of detailed information required. This article shows how job costing can be developed into standard costing and hence into budgetary control. Although specifically prepared in relation to die-casting, much of the precept and practice equally well applies to sand founding.

Job Costing

In any manufacturing concern, the financial accounts give the following information (in greater detail):—

Materials used in manufacture ..	£
Productive labour	£
Overheads (*i.e.*, all expenses excluding appropriation of profit)	£
Total cost	£
Net profit (or loss)..	£
Sales	£

By simple division, it can be shown that the overheads are x per cent of labour—an easy formula for costing any job and one which is widely employed in every industry. But if costing is carried no further, it could not be more false; overheads, unfortunately, do not rise and fall so exactly with the wage bill! Where this formula is used in sales estimating, this will be the effect—a "bumper" year will decrease the overhead percentage, sales orders will be easier to obtain, but net profit realized may be smaller; a moderately poor year will increase the overhead percentage, sales orders will be more difficult to obtain, and the net profit realized will approach nil.

Examining these awkward overhead expenses, they can be segregated into the following broad groups:—

(*a*) *Fixed.*—(i) Expenses which are incurred even if the foundry is closed, *e.g.*, rent, depreciation. (ii) Expenses which are incurred so long as there is some production, *e.g.*, salaries of permanent staff.

(*b*) *Semi-variable.*—Expenses which vary indirectly with output, *e.g.*, repairs and maintenance of plant.

(*c*) *Variable.*—Expenses which vary directly with output, *e.g.*, service labour, maintenance of dies.

Marginal Costing

This segregation of overheads can be utilized in a development of job costing, called marginal costing. If the fixed overheads are excluded, a new (and lower) overhead percentage can be obtained (often expressed as a rate per hour of production). Then, in sales estimating, the marginal productive cost (materials, labour and the new overheads) is also the minimum selling price—a useful bit of knowledge in times of keen competition. The marginal profit (SP less MPC) must necessarily cover the fixed overheads before any real profit is made; it is therefore essential when using this device, to ensure that that is achieved before the total productive capacity of the foundry has been bespoken.

Standard Costing

Standard costing, as the name implies, is based on a set standard of production, allied with an estimate of sales and the anticipated expenditure for that production. Initially, the setting of these standards is a laborious process—first an intensive research is made into past records, tabling every item of cost, from ingots to ink, against volume of sales, volume of output, number of personnel of every type and grade, etc. Next, the various costs are adjusted to conform with current prices and wage rates. Then costs are calculated (in detail for each centre of activity) for the set standard of output, and finally agreed with and by each person of authority. In its complete form, standard costing demands that the financial books be written up showing "standard" and "actual" costs; thus exposing immediately the effects of price variation.

Control—that is, the comparison between estimated costs and actual costs, and the investigation into their differences—is part of the function of costing, an important part. Yet it is so often overlooked or neglected that it has been "rediscovered" only recently, re-gilded with the basic requirements of standard costing and introduced to industry under the title of *Budgetary Control.* In operation, a budget is compiled for a given period of production—three, six, or 12 months. Short-term ones are always in detail, while long-term ones are more conveniently shown in broad outline. For the agreed level of production, each executive estimates the expenditure to be incurred within the limits of his authority, be it department, section or sub-section. Then, when the actual results are available and compared with the budget, extravagances and economies are "spot-lighted" and responsibility for them can be placed in the right quarters. This scheme, therefore, is an invaluable tool for management. In practice, budgetary control can embrace any or all of the costing systems previously mentioned.

Costing of Gravity-die-castings

PRACTICAL CONSIDERATIONS

A costing system should be tailored to the size and form of the individual firm, but the basic principles of the system should apply throughout the industry, if only for the sake of uniformity. Therefore, whilst the writer advocates the adoption of budgetary control, he also suggests that the detail and accuracy of standard costing is not an essential in a small jobbing foundry. The control of the major items of a budget, however, is essential—such as, production, labour (direct and indirect), metal.

Term of Budget

Work of a jobbing nature eliminates long-term planning, but it takes longer than a day for a die to be translated from the drawing board to the foundry floor. So a budget for four weeks ahead is practicable and one for the following 12 or 13 weeks not impossible.

Period of Production

Cost records and statistics find the 4-weekly period ideal; debtors, creditors and Government returns demand calendar months. The writer puts forward that it would be an excellent compromise to decide on a period of three months, made up of two 4-week periods and one of 5 weeks.

Target for Production

"Tonnage of output" is a popular yardstick. It holds good only as long as the ratio between production wages and weight or cost of metal in each and every casting remains constant—a phenomenon which can occur in a foundry producing only one type of casting! The "standard hour" on the other hand, is a constant unit of production. Its definition is "the amount of work which one man can produce in one hour."

Example:—

10 casters on a 44-hour week will produce in

	Standard hours
4 weeks = 10 × 44 × 4 =	1760
Deduct 5 per cent. for absenteeism	176
Deduct 5 per cent. for setting up and taking down dies	
Standard output for the period = ...	1584

This total may be further trimmed to allow for the usual difficulty in "working in" a new die. In many industries, all productive labour is aggregated into the standard output, but it is submitted that in this case the output of the casting section is the time-limiting factor.

Direct Labour

The operations falling under this heading are:—(1) Casting; (2) coremaking; (3) cutting-off (runners and risers); (4) fettling; and (5) polishing, assembling, etc. Items (1) (4) and (5) are usually paid for under piecework agreements; estimates made on the lines of the example in the previous paragraph should present no difficulty. However, these piecework rates are calculated on "basic rates" while an additional rate is payable in respect of cost-of-living bonuses and other national awards. Furthermore, sales estimates by which quotations and orders are fixed, are calculated on the piece-work rates. Therefore, the national-award payments should be classed as an overhead, although they apply to production labour.

Item (2), coremaking, normally an inexpensive service when die-casting, may be conveniently shown as an overhead. Item (3), cutting-off runners and risers, necessarily occurs on each and every casting, may also be classed as an overhead.

Metal and Metal Loss

For a short-term budget, the estimate for metal will be obtained from the production programme. This being net weight one must allow for metal loss which normally occurs by way of dross and grindings and is partially recovered through sales of such sweepings. This loss is generally expressed as a set percentage applicable to all metals. Here lies the source of incalculable loss when using high-grade and branded metals. These costly metals have a restricted application, in that runnners and risers may not be melted more than once or twice. On a subsequent melting, the metal is down-graded—a £200-a-ton metal, after being melted twice, is then worth perhaps only £180 a ton, without any great change in bulk and certainly without producing castings! Therefore, while the weighing of all returns to the furnaces may be impractical, the down-grading of costly metals should be carefully recorded and a new metal loss percentage calculated for the branded metals and this figure employed in the sales estimates.

For a long-term budget, one must look to the order book for tonnage and apply an average price per ton of metal, if the types of metal are not known.

Melting Costs

Melting costs are segregated, because they vary more or less directly with tonnage output. The costs will include fuel (gas, electricity, oil or coke), crucibles, fluxes, repair and maintenance of furnaces, furnace sundries (materials and labour), and depreciation. Air, if used, will be produced by compressors and stored in receivers and therefore their running costs (electricity, maintenance and depreciation) must be included. One problem under this heading is that gas and electricity bills are rendered for the whole foundry; this can be solved by the installation of separate or subsidiary meters. The scaled charges for gas and electricity are another problem which can be overcome by deciding on a fixed price per unit. Finally, it should be borne in mind while budgeting, that melting will cost more in cold winter months than in hot summer months.

Overheads

Works overheads.—These should be allocated over each centre of activity (or cost centre)—not

forgetting the three categories (fixed, semi-variable and variable)—on agreed bases, *e.g.*, rent, rates and depreciation of buildings by floor area; supervision, works clerical and general labour by number of production personnel; electric power by horse-power of machine, and so on. Cost centres may conveniently follow the analysis of direct labour, *i.e.*, (1) polishing, etc.; (2) fettling; and (3) casting. If in doubt about the allocation of an expense, it would not prove too inaccurate to class it under cost centre No. 3—Casting—arguing on the premise that that is the one essential process in manufacture. To test the allocations, apply the questions:—(*a*) Assuming the fettling (or polishing) shop be closed permanently, will this expense continue to be incurred? (*b*) If so, will the expense be incurred to the same degree?

Selling overheads.—The efforts of the sales staff "to-day" result in deliveries made in a distant "to-morrow"; it is therefore impractical to hold over these overheads for, maybe, several months. However, they are approximately steady, except when a commission is paid on turnover or some similar scheme.

Office overheads.—These, like selling expenses, are reasonably steady, but it must not be forgotten that a large and semi-permanent fluctuation in the volume of business will necessitate an adjustment in the number of office staff.

Loss on dies may occur because (*a*) the customer has agreed to pay only part of the cost of a die; (*b*) the customer has agreed to pay for the die by means of a surcharge on each casting; (*c*) the foundry has agreed to bear the cost of a die, perhaps to double production of that item. In the case of (*a*), the "loss" may be recovered at an unknown but future date. It is prudent to write it off, but it is not an overhead. With (*b*) the "loss" should be deducted from the total sales value. With (*c*) the cost should be written off at an early date in the financial records. But in costing (and in the budget) the cost may be spread over the periods which will benefit (as in (*b*)).

Rejects

Rejects within the foundry will be disclosed by inspection after each stage of production. When on piecework, direct labour is paid only for *good* products, but the cost of the work already done is lost. In theory, ignoring metal costs, the loss on rejects is the direct labour cost *plus* the proportionate overheads. However, to follow this through may be carrying the niceties of costing too far; it is expedient, at any rate, to transfer the wages paid on the rejects out of "direct labour" and into the "overheads" of the cost centre where the spoiling occurred—a useful check on efficiency.

Customers' rejects must not be confused with those castings returned by a customer for crediting at scrap-metal value—in reality, a purchase of metal by the foundry. These rejects are faulty castings despatched by the foundry and now returned—a total loss. While normally deducted from the gross sales for the period or year, they are, in fact, a production risk and therefore an overhead expense. Rejects which are rectified and re-sold, should, of course, be credited and re-invoiced in the same period.

Pertinent Details

Sales.—This will be the amount that the budgeted production is expected to realize—a fairly accurate estimate obtainable from the order book for a short-term budget, and a shrewd guess for a longer period.

Work in progress should, in theory, remain at a constant value. It is true that fluctuations in the metal content and other factors will cause a rise or fall in value, but these will level out during the course of a year. However, large fluctuations should be anticipated, where possible.

Proving the budget.—Assuming the budget has been drafted for the first time, each item should be scrutinized to see whether it is not over- or understated. Subsequently, the proof of the budget will lie in whether or not the profit disclosed is adequate. If not, a further scrutiny of items must take place. Having done this, the profit finally indicated will equal approximately the actual profit realized for the trading period under the present and *normal* conditions of production. If the profit is still too low, then one must look for the remedy in a permanent increase in output, by means of overtime, greater incentive bonuses, a night-shift or a larger day shift, or a combination of them. This step will necessitate drafting a new budget, as an alteration in the planned output will affect all items but the fixed expenses. At last, the budget can be regarded as complete.

Variables

As soon as the financial results of trading for a period are available, they are compared with the budget and a statement is prepared showing any difference. These differences, called "variances," may be due to—

(1) Calendar, *i.e.*, the number of working days in the period may have been more or less than planned.

(2) Price, *i.e.*, materials may have increased or decreased in cost, or there may have been a minor alteration in wage rates.

(3) Volume, *i.e.*, many expenses fluctuate in sympathy with the volume level of sales or production.

Having allowed for variances due to calendar, price and volume, there should in theory be no further differences to explain. However, as there usually are, they are called "controllable variances" and demand investigating. They are caused by:—

(1) Circumstances not foreseen or foreseeable; (2) extravagance and inefficiency; (3) economy and efficiency; (4) errors in stock-taking; (5) bulk purchases of items which are not normally subject to stock control; (6) under- or over-estimates in the budget; and (7) in particular regard to metal, the under- or over-estimated weight in the sales estimates.

Costing of Gravity-die-castings

Operating Statements

A schedule is next given to each executive detailing the expenditure under his control and showing against each item the "budget," "actual" and "variances" figures. The executive is requested to comment on the controllable variances. Naturally, it would be unreasonable to expect "actual cost" exactly to equal "budget cost," and therefore some degree of latitude should be agreed upon. The wider the responsibility of the executive, the greater the scope of the operating statement he receives and the less the detail given—the other statements will be available in case of need—until the profit-and-loss statement will be merely a summary of all subsidiary statements, with the major variances "spot-lighted" and satisfactorily or otherwise explained. Statements for subsequent production periods will show "this period" and "total to date" figures.

Further Uses for the Budget

Once the budget system is functioning with a fair degree of reliability, overhead percentages can be calculated from it for use in sales estimating, with the assurance that the percentages will hold good for the production period of the prospective sales. After several budgets, the relationship between a fluctuating output and variable overhead expenses will be better understood, and could be applied successfully on the marginal-cost principle when necessary.

A large controllable variance can too easily be explained away by an executive as being "an error in the budget." However, he set the budget figure, so the error is his! An investigation into the cause of the variance may disclose the need for closer supervision. A greater experience in budgeting will help to answer questions of policy, such as—"Is it better to work five hours' overtime during the week or to work five hours on Saturday morning?"

Supplementary Information

In order to make the operating statements more intelligible to the non-accountant, the following information could be shown, where appropriate:—

(1) Sales in tons; (2) output in tons and standard hours; (3) standard hours for each cost centre; (4) costs expressed as a percentage of sales; (5) expenses expressed as a percentage—direct labour; (6) variances expressed as a percentage—direct labour; (7) melting costs—each expense expressed as a price per lb. of metal produced; (8) metal loss percentage for each type and grade of metal; and (9) number of working days in the period.

Finishing Processes. Many castings undergo further processing (heat-treatment, X-Ray inspection, etc.) at the request of the customer but also at the founder's risk. A small "profit" is normally added to the cost of processing to cover the risk of such processes and the extra handling. Whether or not the "profit" is adequate can be proved by treating each process as a cost centre, which will attract all charges relevant to the processing not excluding the process cost of the castings returned as customer's rejects.

Sand Foundries. While these notes have been written exclusively for a die-castings foundry, it will be seen that most of them can apply to a sand foundry, due allowance being made for the differences in production techniques.

Export Licensing Control Changes

Changes in export licensing control are made by a Board of Trade Order which came into force yesterday (Thursday). Licences will not be required (except for exports to China, Macao, Tibet, and North Viet Nam) for the export of tool-bits, certain turbines, etc.

Licences will be required for the export to all destinations (other than the British Commonwealth, Eire, and the USA) of specified cables, specified cable-making machines, certain generators, turbo-generators, motor generating sets and synchronous condensers, and specified line communications transmission equipment. Licences will be required for the export to all destinations of certain nickel-bearing alloy steels and aircraft refuelling apparatus and appliances.

The Order is the Export of Goods (Control) (Amendment), Order, 1955 (SI No. 984) Stationery Office, price 4d.

DIRECTORS of member-firms of the Gauge and Tool Makers' Association will be able to visit the All-British Exhibition which is being held in Copenhagen, under the auspices of the Federation of British Industries, from September 25 to October 16. The Association also announces the introduction of a certificate of gauge and tool design and draughtsmanship as an incentive to young men anxious to become skilled in these fields.

Lower Rate of Unemployment

Unemployment in Great Britain on June 13 was less than in any June, except 1951, since the war, in spite of the railway and dock strikes. A fall of 13,000 unemployed was recorded. Figures issued by the Ministry of Labour show that at that date there were 211,000 registered unemployed, of whom 30,000 were temporarily stopped, or 1 per cent. of the estimated total number of employees.

In the week ended May 28, about 1,580,000 were reported to be working overtime in manufacturing establishments rendering returns to the Ministry. This was 40,000 less than in February, but 80,000 more than a year ago. The number reported to be working short time was 60,000, which was 20,000 more than in February and a year ago.

The number of workers in civil employment rose by 45,000 during May to 22,850,000. This was 280,000 more than a year previously.

DEVISED by the company's works manager, a 44-hr. week shift indicator produced by the Darwen & Mostyn Iron Company, Limited, Mostyn, Holywell (Flint), should prove most useful to blast-furnace, steelworks, and coke-oven operators, and, indeed, to all involved in the operation of the 44-hr. week. On referring to a man's priority number, the shift he should work on any particular day is simply ascertained by revolving a circular card.

New Equipment

Ingotting by Machinery

The range of ingot casting machines developed by Sheppard & Sons. Limited, of Bridgend, Glamorgan, providing mechanical equipment for the casting and handling of a wide range of non-ferrous metals, is widely known. The similar continuous casting of ingots of special-quality irons and pig-iron, hitherto normally only considered where outputs justify large traditional forms of steelworks pig-casting machines, produced a problem of mechanization which was again a suitable application for the firm's principles of continuous ingot casting. A single-strand machine with 120 moulds was thus developed, incorporating ancillary equipment in the form of water-cooling and lime-spray application and other refinements, and having an output of approximately 15/20 tons per hour.

In the production of zinc slabs, however, there arose a new and interesting problem not hitherto solved by mechanical means. In production of zinc it is essential that the surface of the slab shall be free of ripple and shudder marks, and be of uniform quality, and the large zinc producers of the world have refrained from the consideration of mechanical solution, as normal drives depending on multi-sided drums or large-centre-link chain wheels, are not able to produce the smooth transmission which is so essential. It is claimed that not until Sheppards produced their new booster-driven type machine was satisfaction achieved in the continuous casting of zinc ingots.

This new development is briefly based on the fact that with the normal drive head of link mechanisms chordal action in some degree occurs, and it is this chordal action which is the cause of the ripples on the surface of the ingots. The booster-driven machine comprises a drive unit mounted beneath the machine on a separate foundation with a caterpillar drive which engages the returning empty mould chain by a series of uniformly-pitched steel dogs, so arranged and mounted on the caterpillar chain as to transmit only uniform horizontal motion to the main mould chain.

The first machine of this type was supplied to the Consolidated Mining & Smelting Company of Trail, British Columbia, working in conjunction with the largest electric-reduction furnace in the world, and so successful was this machine that it aroused much favourable comment. This success has resulted in similar machines being ordered and installed by other large American and Canadian zinc producers.

Feeder-head Heating for Ingots

The increasing demand for stainless and high-alloy steels calls for constant review of methods by which output may be boosted within the limits of existing plant, and every phase of manufacture has to be examined for possible improvement in technique, and elimination of waste. Just as with foundry practice, wastage from ingot feeding heads is one of the points in production where obvious savings can be made and considerable attention has been given to different means of reducing the volume of the " hot-top " to this end.

A popular method is to prolong fluid conditions in the ingot head by applying an external heat source and the latest development of this, using oxy/fuel-gas heating, has shown some advantages and a consistent increase in yield. The results to date, confirmed by findings in this country and in America, show that

FIG. 1.—*Oxy-propane blowpipe applied to the " hot-top " of an ingot to assist the feeding process.*

10 per cent. improvement in yield is general, through the reduction of the hot-top to half its previous size, yet ensuring complete soundness of the ingot metal. Oxygen/propane has been quoted as the most suitable fuel-gas mixture. This flame is neutral to most steels at oxy/fuel-gas ratios between 3.25 and 4:1 and the available flame temperature of 2,700 deg. C is adequate for the purpose.

The equipment required for the process (Fig. 1) has been developed by British Oxygen Company, Limited. It is extremely simple, consisting merely of a blowpipe with a suitable nozzle head and a quick-acting gas control valve. Oxygen is available in all works and propane is a low-cost gas which can be supplied in easily transportable cylinders.

New Screening Machine

Quarrymasters are showing much interest in a new Scottish-made screening machine which has been invented by Mr. T. L. Rae, who claims that it is certain to have world-wide application. The prototype, a 30-ton-per-hr. three-deck model, was inspected recently. It comprises three screens with intermediate trays one above the other mounted on an inner and outer frame each of which is carried on a set of inclined laminated springs. The frames are oscillated by a shaft through an eccentric located on top giving with the springs a contrary flow to the material. This passes over the screen in one direction while the undersize travels along the trays in the reverse direction before dropping on to the screen beneath. The machine, which can be driven by either an electric motor or a diesel engine, can be applied to screening road metal, foundry sand, and gravel. A notable feature is the almost complete absence of vibration. The machines, which will range in capacity from 20 to 40 tons per hr, are being marketed both at home and abroad by T. L. Rae (Engineers), Limited, 205, Hope Street, Glasgow. They will be manufactured by J. Cameron MacLean & Company, Johnstone, Renfrewshire.

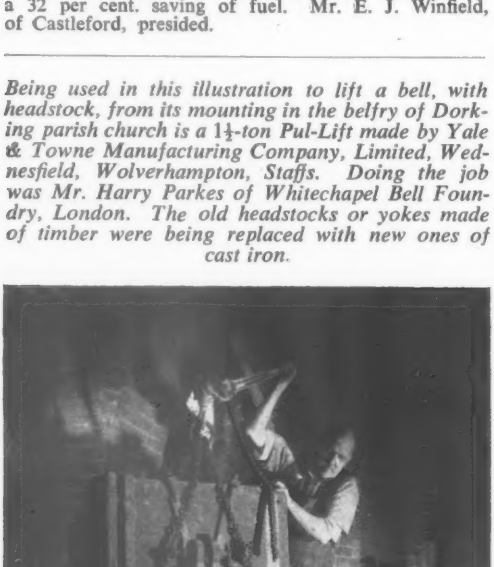
MR. HERBERT FOULSTONE, J.P., former managing director of Needham Brothers & Brown, Limited, iron-founders, Pontefract Road, Barnsley, died in Sheffield on July 24 at the age of 84. He was mayor of Barnsley from 1924 to 1926.

Apathy Towards Smoke Abatement

Speaking at the annual meeting of the West Riding Smoke Abatement Committee in Leeds, on July 14, Mr. H. Pollard, deputy area engineer of the National Industrial Fuel Efficiency Service, complained of the apathy which still existed on the part of many fuel users despite all the publicity about the need for smoke abatement and for fuel economy. He thought there would be more difficulty in overcoming this apathy than in overcoming the technical problems. He saw no real problems in tackling black smoke emission if a big attack were made upon it, and the majority of fuel-burning plants in the West Riding could be adapted now if only people would take the trouble. He did give a warning, however, that it would be unwise to press for complete abolition of smoke, and suggested that their aim should be to reduce smoke emission to the faintest haze. The demand for the complete elimination of smoke might lead to inefficiency in fuel burning. The most frequent causes of black smoke emission were faulty operation by boiler firemen, faulty combustion equipment, unsuitable fuel and basic fault in plant design.

He outlined the work and aims of the NIFES, and mentioned that as a result of the work of the advisory service one Milnsbridge chemical factory had effected a 32 per cent. saving of fuel. Mr. E. J. Winfield, of Castleford, presided.

Being used in this illustration to lift a bell, with headstock, from its mounting in the belfry of Dorking parish church is a 1½-ton Pul-Lift made by Yale & Towne Manufacturing Company, Limited, Wednesfield, Wolverhampton, Staffs. Doing the job was Mr. Harry Parkes of Whitechapel Bell Foundry, London. The old headstocks or yokes made of timber were being replaced with new ones of cast iron.



Meehanite Research Conference

July 5 to 7 in Edinburgh

The 23rd annual conference of the International Meehanite Research Institute was held at the North British Hotel, Edinburgh, from July 5 to 7. Representatives from Great Britain and European countries were present and the subjects discussed covered a wide range of ironfoundry activities, including many new and interesting developments. The conference opened under the presidency of Mr. W. H. Harper, of John Harper (Meehanite), Limited, who welcomed new members. In his address, Mr. Harper referred to the importance of continued research efforts in maintaining progress and achievements, and emphasized the advantages of co-operative activity through the Research Institute.

The chairmen of the various committees then gave accounts of their work during the year. For the technical research committee, Mr. N. Charlton, reported on the activities during the year and those now in hand. Apprentice training at the Meehanite training school was described by Mr. J. E. Spear, for the educational and training group. After his report, the presentation of a gold watch to the winning apprentice was made by Mr. Oliver Smalley, O.B.E.

Technical Session

The technical session then opened under the chairman ship of Mr. Smalley. Reports discussed included the annual volume of "Casting Service Records," representing outstanding achievements in casting developments during the year. These records were considered in some detail and by means of lantern slides the important points of each development were discussed. Then came the presentation of reports on economies in the foundry and ideas for improving production methods. Methods for reducing cleaning-shop costs were next considered and principles were outlined for reducing fettling costs.

The machinability of Meehanite and correct practice for machining castings of this material was the subject of considerable discussion. A report which aroused much interest was an account of the application of the CO_2 Process in the production of castings.

In the "foundry and metallurgical" session, reports were presented on the operation of the hot-blast cupola, and also the basic-lined, water-cooled cupola, representing recent developments in melting practice. In the field of casting production, a detailed account was given, with the aid of a film strip, of the production of a large needle-valve casting. The use of tubular inserts in casting production was also discussed. New developments in ultrasonic testing aroused interest as representing a promising field for economic castings inspection and offering additional assurance to the customer of the soundness of a casting.

In the management session, under the chairmanship of Mr. Harper, the subjects discussed included a progress report on developments of Meehanite in Great Britain, and a report on product development and sales promotion.

The annual dinner was held on the evening of July 6 and was presided over by Mr. E. M. Currie, who welcomed the members and reviewed the work and growth of the Meehanite Institute. The toast of the Institute was proposed by Mr. Spear and responded to by Mr. Smalley. The toast to the visitors abroad was proposed by Mr. John Cameron, O.B.E., and the evening closed with speeches by members from Europe, America, South Africa and Japan.

Life of Ingot Moulds: Conditions of Service, Mould Material and Design, and Metal Composition

Great variations still exist in the consumption of ingot moulds, even when only one design made by one foundry and used in a single melting shop is considered. The third report of the Ingot Moulds Sub-committee, published recently, presents the results of extensive studies of mould performance, the aim of which is to reduce the consumption of ingot moulds. Some of the more important conclusions reached are presented in outline in this article.*

Recommendations were made in the Committee's previous reports, most of which have been adopted in the industry. The results of the changes made are considered in this third report, together with much new work. It is divided into four sections, each dealing with the effect of one factor or a group of related factors:

(1) Conditions of service; (2) chemical composition of mould material; (3) properties and composition of mould metal; (4) mould design.

Effect of Conditions of Service

Recording Mould Data.—A marked improvement in mould life usually takes place when an efficient system of supervision and recording is introduced, especially if the conclusions drawn from a study of the records are put into practice. One melting shop halved its mould consumption in this way. Even so simple a measure as limiting to one responsible person the authority to discard moulds has achieved a 10 per cent. increase in mould life.

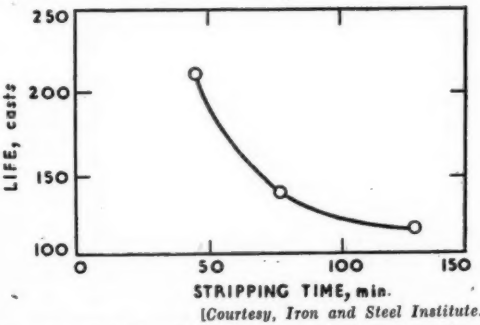
Unless they are so crazed as to be difficult to strip, crazed moulds have no detrimental effect on rimming and balanced steels; there is, therefore, no need for them to be discarded for this reason alone.

Stripping Time.—In general, the more quickly the moulds are stripped from the ingots, the longer are their lives. The life of a mould is not directly proportional to the stripping time, as Fig. 1 shows. Beyond a certain point, an increase in stripping time has no further effect upon mould life as long as the moulds are allowed to cool down to about 100 deg. C. between successive casts.

Mould Interval and Mould Temperature.—The time which elapses between successive casts in the same mould is usually called the "mould interval." It should be long enough to allow the mould to cool to between 50 and 100 deg. C.; the life of a mould is adversely affected if its initial temperature is outside these limits. To use a mould which is too hot is even worse than using it cold. If insufficient moulds are in service, the consequent use of hot moulds will reduce the average mould life. A shortage of moulds is self-aggravating, and a serious situation can arise if the stock is not quickly restored to normal.

Steel Temperature and Speed of Filling.—The greater the superheat of the steel above its liquidus temperature and the greater the speed with which the mould is filled, the more adverse is the effect on the wall of the mould. The use of an immersion pyrometer can not only improve ingot quality but can also increase the life of moulds by avoiding excessively hot casts. Electric arc-furnace steel is usually teemed at higher temperatures and greater speeds than open-hearth steel, and the consumption of moulds is consequently much higher in electric-furnace shops than elsewhere; according to one survey, it is more than twice as great. Steel moulds might be more suitable for use in electric shops, and trials are being made.

Method of Casting: Car, Floor or Pit.—The life of a mould is considerably affected by the method of casting. Anything that retards the dissipation of heat from the walls of the mould shortens its life. Moulds should therefore be spaced as far apart as possible to provide the maximum cooling effect. Pit casting compares unfavourably with floor and car casting, because the walls of a pit retain heat and the moulds in it are usually very closely spaced. These two factors together increase the consumption of moulds by about 20 per cent.



[Courtesy, Iron and Steel Institute.

FIG. 1.—*Relationship between stripping time (tap to finish of stripping) and mould life for 10-ton rectangular moulds.*

Spacing of Moulds.—Ample evidence is available to show that adequate spacing of moulds is an important factor in reducing mould consumption. Where moulds cannot be spaced adequately, some means of forced air circulation may be worthy of consideration.

Method of Running.—Bottom-run moulds have longer lives than top-run moulds. This is because the metal rises more slowly in a bottom-run mould, so that the stress is developed more gradually, and

* Published by the British Iron and Steel Research Association, from 11, Park Lane, London, W.1.

Life of Ingot Moulds

because there is no possibility of a bottom-run mould being damaged by the casting stream.

Method of Cooling Moulds.—It is generally believed that the best method is to cool moulds in air; this, however, takes 10 hrs. or more. Air-cooling is more effective if the moulds stand on a raised grid to enable air to circulate inside as well as outside them. Because air-cooling is so slow, water-cooling is often used. Dipping a partly-cooled mould in water is likely to be less detrimental than immersing it when it is still very hot. Spraying is unlikely to cause much harm, especially if it is carried out in a number of short spells rather than continuously.

Where moulds are widely spaced on cars, the most efficient and economical method of cooling is to keep a large stock of cars and to put the moulds on another set of cars when they are stripped. The moulds are then well spaced for cooling and are ready for immediate use after being handled only once. This method has the further advantage of saving space in the stripping shed.

Chemical Composition

Although the effects of conditions of service can obscure the effects of variations in chemical composition, there is sufficient evidence available to show that chemical composition can have a marked effect on the performance of moulds. The effects of chemical composition are, however, small in comparison with those of design and conditions of service, and to determine the best composition for a given type of mould it is necessary to examine data for a large number of moulds. Even when such a large-scale investigation is made, the results may not be applicable to similar moulds used under different conditions. A chemical composition suitable for all types of mould and all conditions of service cannot therefore be given, but the ranges of composition quoted in Table I have been found to be satisfactory for most conditions:—

TABLE I.—*Ranges of Mould Composition found Satisfactory for most Conditions*

Composition.	Moulds over 10 tons in weight.	Moulds less than 10 tons in weight.
Total carbon	3.6—3.9	3.6—3.9
Silicon	0.8—1.5	1.5—2.0
Sulphur	0.08 max.	0.08 max.
Phosphorus	0.05—0.20*	0.06 max.
Manganese	0.8—1.2	0.8—1.2

* For moulds of between 5 and 10 tons weight, the phosphorus content should preferably be in the lower half of this range.

Properties and Conditions of Mould Metal

Moulds of the same pattern and of similar chemical composition used under the same conditions often show great differences in performance. The reasons for such variations have proved elusive. Attemps to relate the properties or condition of the mould metal to the performance of the mould have met with little success. Nor do those mechanical properties that can easily be tested seem to be the controlling factors. Tests of such properties as resistance to growth and damping capacity may give more valuable information; these properties appear to be more directly related to resistance to crazing and thermal shock.

Mould Design

The importance of good design increases as the mould departs from a circular shape and as its capacity increases. A circular shape is ideal because the thermal stresses in a circular mould are more evenly distributed than in one of square section. A full theoretical analysis of mould design is not yet in sight, and the only way in which the problem could be studied was to conduct surveys of practice. The recommendations made in the report as a result of surveys extended to the USA and Germany as well as Great Britain, are not final answers, but it is thought that moulds designed in accordance with the principles they embody will give the best performance attainable.

Mould-weight/Ingot-weight Ratio.—The ratio of the weight of the mould to the weight of the ingot is of great importance in design. For any given mould and set of conditions there is an optimum value of this ratio; if the mould is too light it will fail prematurely; if it is too heavy, metal is wasted. The conditions of service affect the optimum ratio; moulds used above ground level and well spaced can have thinner walls; moulds used in sunken pits require slightly thicker walls.

Relative Thickness of Different Parts.—In general the walls of the mould should be thickest at those parts which become hottest in service; for example, the centre of the face of a square mould. Moulds with feeder heads should have walls which are thicker at the top than at the base; the walls of moulds without feeder heads should be thickest at the bottom.

Change of Section.—Abrupt changes in contour should be avoided, especially at points where the wall of the mould becomes particularly hot. Quite small changes in design, such as removing a flute or changing the position of a notch, can result in significant improvements in performance.

Open-bottom Moulds.—By using a bottom plate of modified pattern having a raised portion over which the mould fits, one works has trebled the average life of wide-end-up brick-top moulds.

Closed-bottom Moulds.—Failure of the bottom may shorten the useful life of a closed-bottom mould by half, and at many works this type of mould has been abandoned in favour of an open-end design. The recommendations on mould design given in detail in the report, supplemented by diagrams and tables, are confined to moulds up to 60 in. across the top.

A NEW SUBSIDIARY, Aveling-Barford Africa (Pty.), Limited, has been formed by the group headed by Aveling-Barford, Limited, makers of road machinery and earth-moving equipment, of Grantham (Lincs). The group has purchased a controlling interest in the engineering concern of E. W. Gray (Pty.), Limited, Steeldale, Johannesburg, on whose premises the new company's head office is located. Branch offices have been opened in Durban and Capetown and a third is to be opened in Salisbury, Southern Rhodesia, on August 1.

Parliamentary

Relations in Engineering Industry

Replying to MR. ELLIS SMITH (Lab.), who asked if the Minister of Labour and National Service was aware of the 40 years' worsening relative position of craftsmen and other skilled men in the engineering industry and whether he would appoint a committee to investigate and report, SIR WALTER MONCKTON said there had naturally been changes in relative wage rates in engineering and many other industries during the past 40 years, but he saw no need for the investigation suggested.

In a further question MR. ELLIS SMITH asked the Minister to state, in view of current unrest in the engineering industry, what action was taken by his predecessor on the Report on the Relations in the Engineering Industry (Cmd. No. 7511, 1948).

SIR WALTER replied that in accordance with normal practice the report was referred to the parties for their consideration.

MR. ELLIS SMITH asked if it was now intended to take any action with a view to modernizing the joint consultative and negotiating machinery in the engineering and shipbuilding industry following on the report.

The MINISTER said that the modernization of the joint machinery in those two industries which was not specifically dealt with in the Court's recommendations, was a matter for the two sides of the industries concerned. The services of his department were always available to advise and assist the parties if they so desired.

Pig-iron Prices

Pig-iron suppliers controlled by the Iron and Steel Board were charging rail transport to small firms of ironfounders who were obliged to collect their own supplies by lorry during the recent rail strike, but were not making this charge to large firms of ironfounders, said MR. OSBORNE (Con.). He asked the President of the Board of Trade if, in view of the harm done to the national interest through this discrimination against small firms, he would give a direction under Section 10 of the Iron and Steel Act, 1953, to cancel this charge.

MR. A. R. W. LOW, Minister of State, who replied, said that prices for pig-iron determined by the Iron and Steel Board were maximum prices varying between zones in which delivery took place. The President of the Board of Trade would certainly not wish to intervene to prevent producers and consumers negotiating prices below these maximum prices in the ordinary course of business; nor was he aware of any circumstances arising out of the conditions brought about by the rail strike which would justify him in giving a direction under Section 10.

ASKED WHAT SAVING he expected to make as a result of the transfer of the engineering and iron and steel divisions to the Board of Trade, the Minister of Supply replied: "In terms of staff, 250; and in terms of total expenditure, £576,000."

LORD HIVES, chairman of Rolls-Royce, Limited, is to be the first chairman of a council responsible for making national awards in technology in technical colleges. The Minister of Education said that the council was to be established forthwith.

THE CHANCELLOR OF THE EXCHEQUER said on July 19 that the Prime Minister's recent discussions on industrial relations with representatives of all sides of industry are to be followed by further talks with those concerned, over which Sir Walter Monckton, Minister of Labour and National Service, will preside.

The Minister of Labour and National Service said that of the total working days lost in stoppages due to industrial disputes between the beginning of 1946 and the end of May, 1955, approximately 30 per cent. were lost in coal mining, 14 per cent. in the docks, 20 per cent. in engineering and shipbuilding, and 1 per cent. on the railways.

MR. HAROLD WATKINSON, Parliamentary Secretary to the Ministry of Labour, told Mr. Osborne (Con.) that he was aware of the shortage of labour in some of the basic industries, including coal mining. Most of the increase in employment in the last 12 months had been in the manufacturing industries, particularly in engineering, which were not necessarily less important than the basic industries. His local offices were instructed to give special attention to vacancies in the more important industries.

New Attitudes Needed in Industry

Britain must solve the problem of the 2,000,000 working days lost in a year, declared Mr. R. A. Butler, Chancellor of the Exchequer, at Woodford Green (Essex) on July 16. He said: "I do not think that legislation or compulsion ought, or are likely, to have any part in a lasting solution. It is new attitudes, in management, trade unions, and shareholders alike, that will be required.

"For managements it means bringing their workpeople more closely into partnership, not only by the introduction of profit-sharing schemes, admirable though these are, but by creating the kind of partnership in industry which exists between a conductor and his orchestra," said the Chancellor. "Such a partnership will demand also the wholehearted co-operation of workpeople and trade unions. On them, as on the shareholders also, will rest the duty of ensuring that the demands they make upon the fruits of production are fair and reasonable."

All this demanded a new spirit of understanding and co-operation in industry. The level of demand at home and the requirements of increasing production threw a special strain on the balance of payments. Mr. Butler added that if there were any signs that further measures of restraint were needed he would not hesitate to adopt them.

Industrial Rating

When the House of Lords gave a second reading to the Rating and Valuation (Miscellaneous Provisions) Bill on July 11, VISCOUNT KILMUIR, Lord Chancellor, stressed the difficulties in the way of re-rating industry—at present derated as to three quarters of its value. Lord Kilmuir pointed out that the problem affecting industry could only be dealt with in the light of the review of local government finance. Important changes in industrial rating should not be made without a simultaneous review of the Exchequer grant.

Before the Government could agree to the repeal of derating, Ministers would have to be satisfied that no harm would be done to the national economy, Lord Kilmuir continued. This would necessitate taking into account the effect of a rating change on individual industries. The burden might possibly fall most heavily on the basic industries and on some of the more important export industries, and if this were so the result for the national economy might be serious.

Institute Elects New Members

At the Council meeting of the Institute of British Foundrymen held in London on June 20, the following were admitted to membership of the Institute in the grades indicated:—

AS MEMBERS

E. T. Ball, Coalbrookdale Company, Limited, Coalbrookdale, Shropshire.
Christina M. Bather, Chamberlin & Hill, Limited, Lichfield.
H. F. Box, Hilger & Watts, Limited, Loughton, Essex.
M. S. Dwa, Tata Iron & Steel Company, Limited, Jamshedpur, India.
J. O. Edwards, Mines & Technical Surveys, Inviscal Metallurgy Division, Ottawa, Canada.
A. J. Flynn, Bagshawe & Company, Limited, Dunstable.
G. S. Gupta, Dina Industries, Limited, Delhi, India.
W. D. Hartley, Fellows & Darby, Limited, Birmingham.
J. P. Humphreys, Foundry Services, Limited, Birmingham.
A. L. Parrott, Morris Singer Company, Limited, London.
E. Taylor, Jackson & Brother, Limited, Bolton.
N. Tranter, F. H. Lloyd & Company, Limited, Wednesbury.
D. Young, William Aske & Company, Limited, Halifax.

TRANSFERS FROM ASSOCIATE MEMBER TO MEMBER

D. Kinnon (Leicester, Lovell & Company, Limited, Southampton.
N. J. Nicholson, Armstrong Whitworth (Metal Industries), Limited, Gateshead-on-Tyne.
A. H. Normington, Broom & Wade, Limited, High Wycombe, Bucks.

ASSOCIATE MEMBERS

D. R. W. Atkiss, C. & B. Smith, Limited, Wolverhampton.
T. Bailey, K. & L. Steelfounders & Engineers, Limited, Letchworth, Herts.
H. S. Bansal, S. A. Singh & Company, Jullundur, Punjab, India.
S. H. Beale, Nuneaton Engineering Company, Limited, Nuneaton.
M. G. A. Biswas, Pakistan Ordnance Factories, Wah Cantt, West Pakistan.
J. W. Brand, Barnard & Sons, Limited, Barking, Essex.
R. Bullock, Victoria Machine Tool Company, North Acton, London.
F. L. Challis, Ford Motor Company, Limited, Dagenham.
M. J. Edwards, Ford Motor Company, Limited, Dagenham.
A. Garratt, K. & L. Steelfounders & Engineers, Limited, Letchworth, Herts.
D. Hall, William Jacks & Company, Limited, London.
E. G. P. Hinds, Foundry Services, Limited, Birmingham.
F. Jones, H. Wallwork & Company, Limited, Manchester.
W. T. Lowes, Davy United Roll Foundry, Limited, Haverton Hill, Co. Durham.
J. W. Lucioli, W. Brown, Hitchin, Herts.
D. Mellor, Britannia Iron & Steel Works, Limited, Bedford.
K. P. Misra, Hastings Mill, Limited, Rishra, Dist. Hoogly, India.
D. W. Moore, Maclands, Limited, Aldershot, Hants.
G. McCormick, Jones & Campbell, Limited, Larbert, Stirlings.
K. McDowell, Barrow Hematite Steel Company, Limited, Barrow-in-Furness.
B. A. Naylor, Royal Aircraft Establishment, Farnborough, Hants.
B. F. Olds, K. & L. Steelfounders & Engineers, Limited.
H. Skeldon, Bristol Foundry Company, Bristol.
P. B. Stanley, T. H. & J. Daniels, Limited, Stroud, Glos.
J. R. Woolley, Sterling Metals, Limited, Coventry.
J. E. Wynn, T. H. & J. Daniels, Limited.

TRANSFERS FROM ASSOCIATE TO ASSOCIATE MEMBER

R. N. Biswas, India Iron & Steel Company, Limited, Kulti, Bengal, India.
R. H. Bracewell, Sterling Metals, Limited, Coventry.
A. J. Buck, Bristol Aeroplane Company, Limited.
A. H. Pendleton, Sterling Metals, Limited, Nuneaton.
B. Trought (Awaiting appointment).
G. S. Ubhey, Capital Building Company, Nairobi, East Africa.

ASSOCIATES (over 21)

Y. P. Bhasin, W. H. Allen Sons & Company, Limited, Bedford.
G. Cooper, McMillans Foundry, Farlington, Hants.
M. J. Harrison, Centrax Power Units, Feltham, Middlesex.
F. G. Holden, Mullards, Limited, Blackburn.
J. L. Lunn, Ford Motor Company, Limited.
L. C. C. Smith, Ford Motor Company, Limited.
L. F. Taylor, Idoson Motor Cylinder Company, Limited, Tipton, Staffs.

ASSOCIATES (under 21)

F. Allinson, W. Shaw & Company, Limited, Middlesbrough.
D. Green, British Insulated Callenders' Cables, Limited, Prescot, Lancs.
A. C. Griffin, Ford Motor Company, Limited.
A. D. Harris, F. H. Lloyd & Company, Limited.
P. D. Mahapatra, student, Industrial Training Institute, Calcutta, India.
C. F. Monaghan, Grayson, Rollo & Clover Docks, Limited, Liverpool.
C. M. Neale, John I. Thornycroft & Company, Limited, Southampton.
R. G. Perry, Grayson, Rollo & Clover Docks, Limited.
A. F. Pierce, Grayson, Rollo & Clover Docks, Limited.
E. Sampson, Campbell & Isherwood, Limited, Liverpool.
D. Smith, Ruston & Hornsby, Limited, Lincoln.
J. J. Taft, B.S.A. Company, Limited, Birmingham.
B. L. Wall, T. H. & J. Daniels, Limited.
B. J. Wright, Simmons (Patternmakers), Limited, Nuneaton.

Company News

GEORGE KENT, LIMITED, engineers, of Luton (Beds)—A final dividend of 12 per cent. is announced, making 15 per cent. for the year to March 26, against 12½ per cent. in the previous year.

BRITISH OXYGEN COMPANY, LIMITED—The company is issuing 3,247,079 £1 ordinary shares at 50s. each on the basis of two for every £5 of stock held on June 27. Stockholders will be able to apply for excess shares. The new shares will not be entitled to any interim dividend for the nine months' accounting period to September 30, but will be entitled to the full amount of any final dividend for that period.

EFCO, LIMITED (formerly the Electric Furnace Company, Limited)—For the year ended March 31, a final dividend of 10½ per cent. is recommended on the £313,000 ordinary capital as doubled by a free scrip issue in January. With the interim of 4½ per cent. paid on the former capital, the total dividend is equivalent to 12½ per cent. on the present equity. This compares with an equivalent 5 per cent. for 1953-54 when 10 per cent. (interim 3½ per cent. and final 6½ per cent.) was actually paid on £156,500 capital.

BILSTON FOUNDRIES, LIMITED—Of the issue of 700,000 ordinary shares of 2s. each at 4s. 6d. per share, 690,776 have been accepted by shareholders on provisional allotment letters. Applications from more than 500 shareholders for excess shares totalled over 320,000, or approximately 35 times the number available. After according preferential treatment to applications from employees and customers in accordance with the directors' circular, applications for under 50 shares have been allocated in full and applications for 50 shares and over will be dealt with by ballot, successful applicants receiving 50 shares each.

ASSOCIATED ELECTRICAL INDUSTRIES, LIMITED—In connection with the proposed offer for the preference stock of Siemens Bros. & Company, Limited, Lord Chandos, chairman, states that to give effect to the decision the company's authorized capital must be increased by at least £1,100,000. The board, however, recommends increasing the authorized capital by a further £5,900,000 by the creation of a total of 7,000,000 unclassified shares of £1 each. Of the shares up to 1,100,000 would be issued as 4½ per cent. "B" cumulative preference shares of £1 each to Siemens Bros. 10 per cent. preference stockholders, if the above offer is accepted. There is no present intention of making a further issue of shares.

AN INVENTORY of items available and suitable for exhibits in a future museum covering all aspects of the city's industries is being made by Mr. H. Raymond Singleton, director of Sheffield City Museums, with the help of Sheffield Junior Chamber of Commerce.

Pig-iron and Steel Production

Statistical Summary of April Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarizes activities during the past six months. Table II gives production of steel ingots and castings in April, and Table III, weekly average production of finished steel. Table IV gives the production of pig-iron and ferro-alloys in April, 1955, and furnaces in blast. (All figures weekly averages in thousands of tons.)

TABLE I.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

Period.	Price Index, 1938 = 100. I. & S.	Price Index, 1938 = 100. Coal.	Price Index, 1938 = 100. All comdts.	Iron-ore output.	Imptd. ore used.	Coke to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy). Imports.[1]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[2]
1953	260	350	323	304	207	237	215	188	18	339	262	962
1954—Nov. ..	266	272	326	302	241	341	235	211	6	377	303	900
Dec.[3]	267	372	331	301	236	240	234	196	7	355	285	831
1955—Jan. ..	268	373	333	303	243	240	236	213	11	381	298	828
Feb. ..	269	373	334	315	246	242	242	220	17	394	314	812
Mar.[3] ..	269	375	330	322	239	244	241	225	28	395	319	808
April ..	269	375	329	310	234	242	238	224	29	393	—	844

TABLE II.—*Production of Steel Ingots and Castings during April*, 1955.

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex ..	—	4.2	14.0(basic)	1.9	0.2	19.3	1.0	20.3
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire	0.7	30.4	—	2.1	0.4	32.4	1.2	33.6
Yorkshire (excl. N.E. Coast and Sheffield) ..	—	39.0	—	—	0.1	39.0	0.1	39.1
Lincolnshire	1.3	77.5	—	1.3	0.4	78.7	1.8	80.5
North-East Coast	3.1	43.2	—	1.9	0.4	46.7	1.9	48.6
Scotland	—	18.2	—	1.0	0.7	18.2	1.7	19.9
Staffs., Shrops., Worcs. and Warwick	5.5	80.4	5.9 (basic)	1.2	0.1	92.4	0.7	93.1
S. Wales and Monmouthshire	7.9	32.9	—	10.4	0.4	49.8	1.8	51.6
Sheffield (incl. small quantity in Manchester) ..	—	1.4	4.6 (acid)	0.5	0.1	6.5	0.1	6.6
North-West Coast								
Total	18.5	327.2	24.5	20.3	2.8	383.0	10.3	393.3
March, 1955[3]	20.4	324.1	24.9	22.1	3.4	383.4	11.5	394.9
April, 1954	18.6	306.9	22.7	16.9	3.2	358.5	9.8	368.3

TABLE III.—*Production of New Non-alloy and Alloy Finished Steel.*

Product.	1953.	1954.	1954. March.[3]	1955. Feb.	1955. March.[3]
Non-alloy steel:					
Ingots, blooms, billets and slabs[4]	4.7	5.1	5.3	5.0	4.8
Heavy rails ..	8.7	9.6	10.7	10.1	11.1
Sleepers, etc. ..	2.2	1.9	3.0	2.5	1.7
Plates, 3 mm. thick and over ..	46.5	47.0	49.7	47.7	47.6
Other heavy prod.	43.9	45.8	48.5	50.9	51.8
Ferro-con. rods, etc.	5.1	5.9	5.6	6.5	7.0
Wire rods and other rods	15.6	19.7	18.3	23.5	23.0
Light rolled prod.	44.2	41.2	40.2	48.5	48.3
Bright steel bars ..	6.7	6.3	6.3	7.9	8.2
Hot-rolled strip ..	18.8	21.7	23.1	24.4	25.3
Cold-rolled strip ..	5.2	7.0	6.9	7.8	8.1
Sheets, incl. coated	34.1	38.8	40.6	44.9	46.2
Tin, terneplate and blackplate ..	14.9	16.8	18.6	16.6	18.8
Steel tubes, pipes ..	20.1	20.0	20.5	22.3	23.7
Tube pipe fit'gs. ..	0.3	0.4	0.4	0.4	0.4
Tyres, wheels axles	4.4	4.7	4.8	5.7	4.8
Forgings (excl. drop forgings) ..	3.1	2.6	2.8	2.7	2.6
Steel castings ..	4.0	4.0	4.1	4.2	3.9
Tool and magnet steel	0.3	0.2	0.3	0.3	0.3
Total	282.8	298.7	309.7	331.9	337.6
Alloy steel	13.7	13.2	13.1	15.8	15.3
Total deliveries from U.K. prod.[5] ..	296.5	311.9	322.8	347.7	352.9
Add: Imported finished steel ..	6.8	5.0	8.0	13.0	17.7
	303.3	316.9	330.8	360.7	370.6
Deduct: Intra-industry conversions[6] ..	42.6	41.5	41.5	48.3	52.4
Total net deliveries of new material ..	260.7	275.4	289.3	312.4	318.2

TABLE IV.—*Production of Pig-iron and Ferro-alloys during April*, 1955.

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	26	2.0	18.2	25.1	1.4	—	46.7
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire	6	—	14.2	—	—	1.4	15.6
Yorkshire (excl. N.E. Coast and Sheffield) ..	—	—	—	—	—	—	—
Lincolnshire ..	10	—	36.3	—	—	—	36.3
North-East Coast	22	4.9	47.1	—	—	1.5	53.5
Scotland	9	—	16.1	2.7	—	—	18.8
Staffs., Shrops., Worcs., and Warwick ..	7	—	9.2	1.4	—	—	10.6
S. Wales and Monmouthshire	9	4.7	32.0	—	—	—	36.7
Sheffield	1	—	2.5	—	—	—	2.5
North-West Coast	8	16.5	—	0.2	—	1.1	17.8
Total ..	98	28.1	175.6	29.4	1.4	4.0	238.5
March, 1955[3] ..	100	27.1	176.8	31.2	1.4	4.2	240.7
April, 1954 ..	105	26.8	171.1	29.2	1.2	3.7	232.0

[1] Weekly average of calendar month.
[2] Stocks mainly ingots and semi-finished at the end of the years and months shown.
[3] Five weeks, all tables.
[4] Other than for conversion into any other form of finished steel listed.
[5] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
[6] Material for conversion into other products also listed in this table

News in Brief

THE CEREMONY of opening a new training centre at the Cookley works of Richard Thomas & Baldwins, Limited, arranged for July 21, has had to be postponed.

COATES INDUSTRIAL HOSTEL at Barnoldswick, which was built during the war to accommodate workers drafted into that area, has been taken over by Rolls-Royce, Limited, who will adapt the main buildings into a welfare centre.

A NUMBER of apprentices from the Staveley Iron and Chemical Company, Limited, recently paid a visit to the Dagenham plant of the Ford Motor Company, Limited. The trip, which comes within their training syllabus, was both instructive and enjoyable.

THE Small Heath group of the B.S.A. Company, Limited, has recently taken over financial control of the Idoson Motor Cylinder Company, Limited, Tividale, Staffs. No change of policy is envisaged and Mr. T. H. Taft will continue to serve as managing director.

TWENTY-ONE employees of Cannon Industries, Limited, Deepfields, Bilston, each with over 50 years' service with the firm, were on July 20 entertained by the directors; twenty of them received presentation clocks.

JAPAN is to hold an international trade fair at Osaka from April 8 to April 22, 1956. Inquiries should be directed to the Counsellor (Commercial), Embassy of Japan, 32, Belgrave Square, London, S.W.1, or to the managing director, Japan International Trade Fair Commission, Honmachi-bashi, Osaka, Japan.

PROPOSALS before Herefordshire Planning Committee to extend quarrying for limestone near King Arthur's Caves, Ross-on-Wye, are arousing the opposition of archæologists and speleologists, who fear that the caves might be irretrievably damaged and the countryside spoilt.

AN INITIAL ORDER for 1,000 of its "L4" Diesel engines has been received by F. Perkins, Limited, Peterborough, for a new medium tractor produced by Chamberlain Industries Pty., Limited, Perth, Western Australia. The tractors are eventually to be turned out at the rate of 3,000 a year.

THE CORONET TOOL COMPANY, of Mansfield Road, Derby, exhibited a new product at the Nottingham Ideal Home Exhibition, it is a 10-in-one "universal" woodworking lathe. The firm have also arranged an agency with a New Zealand firm, which has given an initial order worth £2,000.

MEMBERS of the Traders' Road Transport Association, Limited, who require to park loaded goods-vehicles overnight in Sheffield may secure details of a site available near the city centre from the offices of the Association, 35, Silver Street Head, off Paradise Square, Sheffield, 1; telephone Sheffield 27612.

THE NEW PREMISES of John Blackwood Hodge & Company, Limited, makers of earth-moving equipment, of London, W.1, in Dublin, combining office, spares, and workshop facilities, have been named the Euclid Works to recognize the co-operation between the Blackwood Hodge organization and the Euclid Company of the United States.

A SHEFFIELD INDUSTRIAL EXHIBITION and trades fair is being considered by the city's Chamber of Commerce as part of its centenary celebrations in 1957. The idea was put forward by the Junior Chamber of Commerce. It is thought that such an exhibition would provide a broader representation of Sheffield industry than is available at national fairs.

A MEETING of Monmouth Town Council has agreed to seal a contract, worth £50,894, for the erection of a factory at Hadnock Road and to apply for a loan sanction for £55,950. It has been stated that Scotts Engineering (Newport), Limited, has agreed to take over the premises on a 25-year lease for the manufacture of domestic appliances.

A NEW £1,000,000 heavy-turbine shop designed for the erection and testing of the largest machines at present envisaged for the generation of electric power was opened by Lord Citrine, chairman of the Central Electricity Authority, at Erith (Kent). The new shop is an extension of the Fraser & Chalmers Engineering Works of the General Electric Company, Limited.

A NEW ALUMINIUM PRODUCTION record was achieved by the French company Société Pechiney in 1954, when output rose to 99,000 tons, against 92,000 tons in the previous year. The annual report of the concern says that internal demand was so high that exports had to be reduced, and were only 18 per cent. of the turnover instead of the preceding year's 32 per cent.

TO TAKE OVER the heating, air treatment, and pipework division of the Brightside Foundry & Engineering Company, Limited, a wholly-owned subsidiary, the Brightside Heating & Engineering Company, Limited, has been formed. Mr. Ambrose Firth has been appointed chairman and Mr. T. C. Firth, Mr. W. S. Richards, and Mr. W. B. James have been appointed directors.

THE ENGINEERING BLOCK, the first instalment of York's new Central College of Further Education, was opened on July 22, by Mr. Dennis Vosper, Parliamentary Secretary to the Ministry of Education. It has cost £140,000, and contains new equipment and machinery valued at £30,000. The whole project will eventually cost £800,000 and make provision for 6,000 students.

THE BRITISH TRANSPORT COMMISSION announce that the following contracts have been placed for flat and flat-trolley wagons: R. Y. Pickering & Company, Limited, Wishaw—one, 35-ton flat-trolley wagon, and eight, 45-ton flat wagons; Head, Wrightson & Company, Limited, Thornaby-on-Tees—five, 40-ton flat-trolley wagons. The 35-ton flat-trolley wagon is specially fitted for Continental working *via* train ferries.

DELEGATES to the annual conference of the National Union of Blastfurnacemen, Ore Miners, Coke Workers and Kindred Trades, at Scarborough, passed a resolution urging their national executive to press for a revision of the holidays with pay agreement. This agreement gives members 18 days' paid holiday, payment being based on about 31s. a shift. Members can make more than this amount each working shift.

A METALS GROUP has been established by the Telegraph Construction & Maintenance Company, Limited, with Mr. W. F. Randall, a director of Telcon, as managing director. The new group embraces Telcon-Magnetic Cores, Limited, Chapelhall (Lanarkshire), Temco, Limited, Lydbrook (Glos), Sankey-Telcon, Limited, Crawley (Sussex), and Magnetic & Electrical Alloys, Limited, Burnbank, Hamilton (Lanarkshire).

SIR ALFRED HERBERT, founder and chairman of the Coventry firm bearing his name, who, in 1938, gave Coventry £100,000 for a new art gallery and museum has given a further £100,000 towards the now greatly increased cost of the project. The task of building the Herbert Art Gallery and Museum was started just before the last war. After the war, it proved necessary to choose a new site and a start is to be made on the new building this year.

QUALCAST, LIMITED, ironfounders, are paying a holiday bonus of one week's pay, at average rate, to every worker. In a statement, Mr. V. Jobson, the chairman, said: "Once again we have broken all records in tonnage, output of finished products, wages paid, and profits." He states that overhead expenses have been cut to the lowest for four years and this has made a considerable contribution to the results. "Order books are in a healthy condition, and if we can avoid increases in costs seem likely to remain so."

IN ACCORDANCE with the provisions of the Monopolies and Restrictive Practices Commission Act, 1953, the chairman of the Commission has appointed the following group to consider and to report on the Commission's reference concerning the supply of certain standard metal windows and doors: Sir David Cairns, Q.C., (chairman); Sir Thomas Barnes, G.C.B., C.B.E.; Mr. J. A. Birch; Mr. W. L. Heywood, O.B.E.; Mr. I. C. Hill; Professor Sir Arnold Plant; Mr. C. E. Wrangham, C.B.E.; and Sir Richard Yeabsley, C.B.E.

THE EARTHENWARE and china factory premises of Cartwright & Edwards, Limited, Trentham Road, Longton, North Staffs, were sold by auction on July 13 for £52,500. They were bought jointly by the Manor Engineering Company, Limited, Fenton, and Alfred Clough, Limited, Longton. Subject to planning permission, the Manor Engineering Company propose to build a modern engineering works on the part of the premises known as the Borough Pottery, and to instal a foundry on the china site.

ROLLS-ROYCE, DERBY, opened on July 21 an automatic exchange with almost 1,500 extensions. It is one of the largest private automatic telephone exchange networks ever installed in a works in this country, and is as large as that of a small town. All departments in the works can now inter-communicate without speaking to a telephone operator, and eventually the company's works at Crewe and Glasgow may be brought in. Before this installation, the work of directing the company's internal and external calls required 25 operators, and internal calls averaged more than 1,000 an hour.

THOS. W. WARD, LIMITED, steelworks, Sheffield, were summoned at Sheffield on July 19 for using a vehicle —a mobile crane—in an unauthorised manner, and using it without third-party insurance. It was stated that, in order to shift scrap from a boiler, the crane had to be taken out on to the road, and that broke the vehicle's limited trade licence. The firm was fined £5 on each of two cases. The crane driver, Edward Wakeling, aged 30, of Salisbury Terrace, Sheffield, similarly summoned, was given an absolute discharge, and special reasons why he should not be disqualified were accepted.

A NEW 2,000-ton, four-column press has recently been installed at the Renfrew works of Babcock & Wilcox, Limited, to assist in the production of boiler drums. Up to now, the ends of the steam drums have been pressed in the forge department and machined in the main machine shop. The largest press hitherto available for this particular work has been one of 480 tons, which has involved multi-stage pressing operations for the thicker plates. The new press will enable drum ends of any size so far envisaged to be easily handled and should be of considerable assistance to the future programme in atomic power plant.

PROBLEMS OF STOPPING THE GRIT from the Valley Road power station, Bradford, and the emission of water-vapour and sulphur fumes were discussed at the meeting of the Yorkshire Electricity Consultative Council at Leeds on July 22. Councillor Arnold Walker, of Bradford, asked about the problem, and Mr. G. A. Vowles, Yorkshire Divisional Controller of the Central Electricity Authority, said that Valley Parade was "an old and menacing station." He added that it was the policy of the Authority not to provide the latest electrostatic precipitators which arrest grit, in old stations, because there was no plant available there. They were, however, trying to improve the existing mechanical precipitators.

THE HARGREAVES group of companies, fuel distributors, have concluded an agreement with the Esso Petroleum Company, Limited, whereby they are appointed as distributors of Esso fuel oils over a wide area in the north of England and north Midlands. Supplies will be drawn from the refinery at Fawley, near Southampton. The Hargreaves group will operate its own road-tanker fleet for supplying fuel oils to both domestic and industrial premises. To ensure that the customer has the best advice on fuel selection, the Hargreaves concern is simultaneously expanding its technical advisory service; all operations will be directed from the head office at The Calls, Leeds, 2.

AN APPEAL has been sent out for funds to establish a memorial prize in Leeds University in commemoration of the late Professor Harry Medforth Dawson, the first occupant of the Chair of Physical Chemistry at the University. The appeal is being sent to his former students, colleagues and friends, with the hope of setting up a fund from which an annual award may be made either to an undergraduate or to a research student for outstanding work in physical chemistry. Professor Dawson, who died in March 1939, spent most of his life in the University's service. His scientific reputation, which was international, was based on his contributions to the kinetics of reactions in solutions.

ABELSON & COMPANY (ENGINEERS), LIMITED, of Sheldon, Birmingham, are presenting to the Birmingham Museum of Science and Industry, what is believed to be the last steam locomotive made in Birmingham. The handing over of "Secundus," as the engine is called, took place on July 25 in a ceremony at the company's works, when the Lord Mayor of Birmingham (Alderman A. L. Gibson) formally received the gift. "Secundus" was made between 1860 and 1870 by Bellis & Seeking, now Bellis & Morcom, Limited, and was part of a narrow-gauge mineral-railway system in Dorset which Abelson & Company recently acquired. The engine, which is of considerable historic interest has attracted the attention of several bodies, the firm states, but it was thought appropriate that the engine should be preserved in the city where it was made.

ATTENTION has been drawn to the fact that a news paragraph printed at the top of page 660 of the JOURNAL of June 16 concerning a new book "The Casting of Steel" was somewhat misleading. Actually, the British Iron & Steel Research Association has not sponsored the book. The background is that the original project was started some four or five years ago when Dr. W. C. Newall was head of the Steel Castings Division of the BISRA. A firm of publishers, being aware of the need for such a book, approached them with a view to arranging for it to be written. It was, however, felt that this being a commercial venture, it was not one in which BISRA could properly interest itself and it was arranged that Dr. Newall should take over the editorship of the book and obtain contributions from other people in the industry.

Personal

MR. C. D. MILLER has been appointed a director of the Sturtevant Engineering Company, Limited.

MR. P. D. CROWTHER, chief metallurgist at Peglers, Limited, brassfounders, Doncaster, has been appointed to the board.

MR. P. P. LOVE and MR. R. J. WELSH have been elected directors of Glacier Metal Company, Limited. MR. D. W. PLAISTOWE has resigned from the board.

MR. S. P. THOMAS, B.SC., A.M.I.MECH.E., of Littleover, Derby, has been appointed a member of the East Midlands Gas Consultative Council, by the Minister of Fuel and Power.

MR. D. V. PHELPS, managing director of Pilkington Brothers, Limited, and chairman of Chance Brothers, Limited, Fibreglass, has been elected to the board of the Westminster Bank.

DAVIDSON & CO., LIMITED, of Belfast, announce that MR. H. DUNLOP and MR. C. E. H. ECKERSLEY, M.I.Mech.E., M.Inst.F., have now been appointed directors of the company.

THE BIRMINGHAM BRANCH of the Purchasing Officers' Association recently elected as chairman MR. W. J. SPARKS (Accles and Pollock, Limited); MR. A. B. SMITH (Rover Company, Limited) was elected vice-chairman.

MR. C. W. HEATHCOTE is resigning as a director of Dunford & Elliott (Sheffield), Limited, on taking office as managing director of Dunford & Elliott Process Engineering, Limited, the company's newly formed subsidiary.

TUBE INVESTMENTS, LIMITED, announces that on reaching retirement age MAJOR W. F. F. SCOTT, M.C., director of training and welfare, will retire from the board and relinquish his appointments within the company on July 31.

MCKECHNIE BROTHERS, LIMITED, announce the appointment of MR. W. D. MCKECHNIE as sales manager (Lithopone) with effect from August 1. Mr. McKechnie previously held the post of assistant sales manager for this pigment.

MEEHANITE METAL COMPANY, LIMITED, 4, Downside, Epsom, Surrey, announce that MR. P. ATTENBOROUGH, MR. G. HOBMAN and MR. E. W. HARDING have been appointed to their board of directors, with MR. E. M. CURRIE as managing director.

MR. DENIS BARON TWIDALE, of the British Electricity Authority, Kirkstall Power Station, Leeds, has been elected an associate member of the Institution of Mechanical Engineers. MR. EDGAR LIGHTFOOT, of the Department of Civil Engineering, the University of Leeds, has been elected an Associate of the Institution.

MR. ERNEST F. THOMPSON, works manager of the Dowlais (South Wales) factory of the Small Heath group of the B.S.A. Company, Limited, has been appointed works manager of the Redditch (Worcs) factory, including the B.S.A. precision-casting foundry. Mr. Thompson joined the company in 1930 as an apprentice.

MAJOR C. J. P. BALL, who has been chairman and managing director of Magnesium Elektron, Limited, since the company's formation in 1934, has been succeeded as managing director by DR. C. J. SMITHELS. Major Ball remains chairman of the company. BRIG. A. G. COLE, previously assistant managing director, has been appointed commercial director. DR. S. J. FLETCHER remains technical director.

MR. ERIC RUSSELL has been elected to the board of directors of Herbert Morris, Limited, Loughborough. He has been associated with the firm since 1921, and for some time was at their Cardiff and London offices. In 1929, he was appointed manager of the company's office at Glasgow, until 1945, when he left to take up an appointment with another engineering firm. His present appointment takes effect from September 26.

Mr. A. D. BUSBY, B.Sc., A.I.M., who has been a member of the development and research department of the Mond Nickel Company, Limited, for 18 years —first in the research laboratory, Birmingham, and for the last five years as development metallurgist on alloy and special cast-irons—has resigned his position. As from September 1, he is taking up the post of deputy process-development manager of the titanium department, I.C.I. (Metals), Limited, Witton, Birmingham.

MR. CHARLES S. HOWROYD, chairman of Rycroft and Company, Limited, coppersmiths, brassfounders and finishers, Bradford, and of Taylor and Parsons, Limited, mill and factory furnishers, Bradford, has announced that MR. E. FISHER and MR. C. THOMPSON, who have both been with Rycroft and Company, Limited, have been appointed to the board, and MR. N. FEARNLEY, with 42 years' service, and MR. H. HANSON, with 43 years' service, have been appointed to the board of Taylor and Parsons, Limited.

Mr. EDWIN FLETCHER has been appointed deputy director of the European Productivity Agency. Mr. Ted Fletcher—as he is generally known—has been in charge of the British TUC production department since its formation in 1950. He is an M.A. of Cambridge University, where he read economics. He is also an Incorporated Accountant. For the period 1948-1953, Mr. Fletcher was a member of the Advisory Council of the Department of Scientific and Industrial Research and chairman of its Industrial Grants Committee in 1952-53.

Mr. H. J. GOLDSCHMIDT, who has been on the research staff of the B.S.A. group Research Centre at Greystones Hall, Sheffield, since 1944, has been awarded the D.Sc. degree of Manchester University for his collected published researches since 1938 when he joined the research staff at William Jessop & Sons, Limited, special steelmakers, Brightside, Sheffield. He is widely known as an outstanding industrial research worker who has applied the methods of X-ray analysis to a wide variety of industrial problems. He recently developed an X-ray camera for operation at high temperature. Dr. Goldschmidt gained his first degree in physics at Manchester, and then his M.Sc. degree by researches on alloy systems under Sir Lawrence Bragg, Langworthy professor of Physics, and Dr. A. J. Bradley.

Obituary

WITH THE DEATH on July 19 of SIR ALLAN JOHN GRANT, at the age of 79, a link with the great developments in the steel industry between the wars is broken. In Sheffield in particular he will be remembered as a prominent citizen, whose public-spiritedness ranged not merely over the national interests of the industry but entered into the international sphere. In 1911, Sir Allan began his career with John Brown & Company, Limited, which was to last for more than 40 years. Among the appointments he held in that period were the presidency of the British Iron and Steel Federation, the office of Master Cutler. and the presidency of the Sheffield Chamber of Commerce.

FIRST WITH W20

Now BEETLE RESIN *W42

This new synthetic resin core-binder has been specially developed to suit those foundries where fumes and casting odours cause embarrassment. The result of practical co-operation between B.I.P. and leading foundries, Beetle W42 is another example of B.I.P.'s pioneer research and service to the Foundry Industry. W42 has been formulated with the Garrett Report in mind and it possesses all the advantages of Beetle Resin W20, coupled with this important new feature . . .

reduced casting odour

* *Patent Application 32896/58*

B·I·P

Write for technical information to B.I.P. Chemicals Limited, Tat Bank House, Oldbury, Nr. Birmingham

London Office: 1 Argyll Street, W.1. *'Beetle' is a trade mark registered in Great Britain and in most countries of the world.*

Raw Material Markets

Iron and Steel

Foundry pig-iron carries a higher increase—9½ per cent.—than any other product in the new price lists which became operative on Monday. Foundry owners accept the increases with resignation, but hardly with equanimity, for although order-books are mostly full, the addition to costs is serious, and may affect the flow of export business, to which the Chancellor attaches so much importance.

Explaining the increases, which cover the whole range of iron and steel products, the Iron and Steel Board points out that costs of production have been affected by advances in various items; notably, the higher price of coal (and therefore of coke), the increase in the landed cost of imported materials, the June increase in railway rates, and the general wages increases which have recently been negotiated within the iron and steel industry itself.

No. 3 foundry iron, delivered Birmingham, is 28s. higher at £16 13s. 3d. Hematite is up 22s. 6d. and basic pig-iron 21s.

Now that improved deliveries of raw materials are forthcoming from both home and overseas sources, iron and steel outputs may be expected to be stepped up following the recession in June due to the rail and dock strikes. Nevertheless, holiday influences will have a retarding effect on production for a time.

Foundries generally are very busy, although the pressure on the light foundries is perhaps not quite so strong as it was. The light and the jobbing foundries use mainly high-phosphorus pig-iron, output of which is just about keeping pace with demands; the absence of stocks at the consuming end, however, is often the cause of inconvenience.

The speciality, motor, and general engineering foundries are being pressed for high-duty castings, but, unfortunately, their pig-iron requirements cannot be met adequately. They utilize low- and medium-phosphorus irons, hematite, and the refined grades. As much use as possible is being made of refined irons, makers of which are booked for weeks ahead. A little imported iron is coming through, but it is very high in price.

As a result of the recent increase in the price of coal, the Ministry of Fuel and Power has authorized an increase in the price of Durham and Welsh foundry coke of 20s. 9d. per ton as from July 18.

So far as the re-rollers are concerned, there is a slight improvement in the raw material position due to the arrival of imported steel semis. Most of them are short of labour and the absence of sufficient manpower is retarding outputs. Re-rollers are heavily sold ahead for the home trade and for export.

Non-ferrous Metals

Figures issued by the Copper Institute in New York for June show that in the United States production of crude copper was 4,000 short tons lower, at 102,800 tons, and output of refined decreased by 3,600 tons to 131,400 tons. Deliveries, the true measure of activity, improved by about 8,000 tons, however, to 132,800 tons. There was a further drop in stocks of refined copper in producers' hands to about 38,500 tons, which at the present rate of consumption is equal to little more than one week's requirements.

Outside the United States production of refined copper was down by some 7,700 tons to about 109,000 tons, but the output of crude was up to the extent of 6,800 tons, at 142,100 tons. Deliveries of refined copper, at 115,900 tons, registered an increase of some 6,900 tons.

On the London market on Tuesday cash copper reached a record price of £371 in active trading, but the rise was not held. On Monday the three months price had touched £367 10s.—the highest ever recorded—but values fell away later in the day.

Throughout last week the turnover was only moderate, but the undertone was firm. The continuation of the US copper strike, which has been in force since July 1, has helped the trend. Loss of output at the three producing units concerned looks like amounting to 50,000 short tons and coming on top of the already tight situation has created a serious position for consumers. It has been reported that 47½ cents was paid last week and this may not prove to be the top.

On Whittington Avenue the other metals were firm, although some of the sparkle went out of tin when it became known that ratification of the tin agreement by Indonesia would certainly not come for several months. The rise on the week, however, was £4 cash and £3 10s. forward. Lead continued to be firm, July being 30s. and October 20s. higher.

Official metal prices were as follow:—

COPPER, Standard—*Cash*: July 21, £354 to £354 10s.; July 22, £354 to £355; July 25, £365 to £366; July 26, £370 to £372; July 27, £363 to £364.

Three Months: July 21, £346 10s. to £347; July 22, £347 to £347 10s.; July 25, £357 10s. to £358; July 26, £362 10s. to £363; July 27, £357 to £357 10s.

TIN, Standard—*Cash*: July 21, £766 to £768; July 22, £761 to £672; July 25, £766 to £768; July 26, £769 to £770; July 27, £765 to £766.

Three Months: July 21, £758 to £759; July 22, £754 to £756; July 25, £759 to £760; July 26, £761 to £762; July 27, £757 10s. to £758 10s.

LEAD—*Second half July*: July 21, £107 10s. to £108; July 22, £108 to £108 5s.; July 25, £108 to £108 5s.; July 26, £107 10s. to £107 15s.; July 27, £107 to £107 5s.

Second half October: July 21, £107 to £107 5s.; July 22, £106 15s. to £107; July 25, £107 to £107 5s.; July 26, £107 to £107 5s.; July 27, £106 10s. to £106 15s.

ZINC—*Second half July*: July 21, £91 10s. to £91 15s.; July 22, £91 to £91 5s.; July 25, £91 to £91 5s.; July 26, £90 10s. to £90 15s.; July 27, £89 10s. to £89 15s.

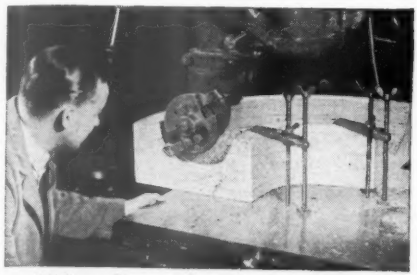
Second half October: July 21, £91 10s. to £91 15s.; July 22, £91 5s. to £91 15s.; July 25, £91 5s. to £91 10s.; July 26, £91 5s. to £91 10s.; July 27, £90 5s. to £90 10s.

BIF Changes

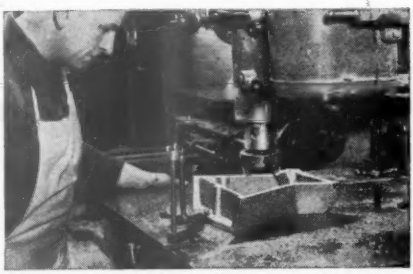
An electrical exhibition will be staged in London as part of next year's British Industries Fair. It will be held in the Grand Hall, Olympia, from April 23 to May 4, 1956. The decision to transfer the electrical section of the Fair from Birmingham to London has been made in response to views expressed by large sections of the electrical industry.

The 1956 BIF is being held at two different times of the year—at Earls Court, London, from February 22 to March 2 and at Olympia, London, and Castle Bromwich, Birmingham, from April 23 to May 4. At Earls Court, light consumer goods such as toys, fancy goods, and jewellery will be on show. Technical products such as chemicals, office appliances, scientific instruments, and electrical equipment will be on display at Olympia. The engineering and hardware section will be at Castle Bromwich, Birmingham.

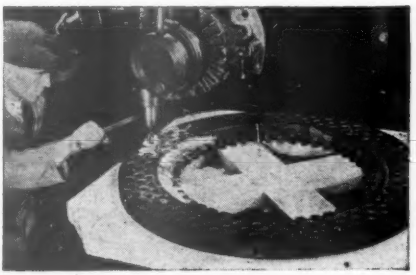
If you are interested in reducing pattern making costs . . .



Wood. *Machining a pipe bend corebox*

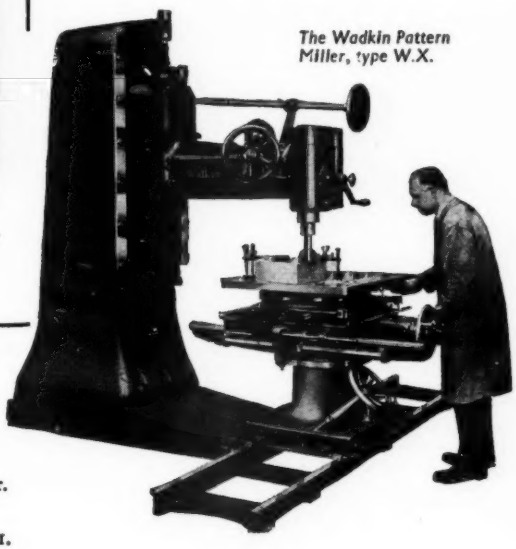


Metal. *Surface milling using a plug-cutter head*



"Permali" *Machining a pattern for a stator clamping ring. Photograph by courtesy of The Electric Construction Co., Ltd., Wolverhampton*

In every Engineers' Pattern Shop, there are scores of jobs that could be done in a fraction of the time and cost on a Wadkin Pattern Miller. Hours of comparatively expensive handwork on wood, metal or composite materials can be reduced to minutes, and with improved accuracy throughout. No other machine offers such big possibilities for saving both time and money. That's why it will pay you to investigate its application to your work.



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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

July 27, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 1s. 0d.; Birmingham, £16 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £18 12s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £19 8s. 3d.

Scotch Iron.—No. 3 foundry, £19 5s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £21 3s. 0d.; South Zone, £21 5s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £22 0s. 0d.; South Zone, £22 3s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £19 5s.; Scotland (Scotch iron), £19 11s. 6d.; Sheffield, £20 12s. 0d.; Birmingham, £20 19s. 6d.; Wales (Welsh iron), £19 11s. 6d.

Basic Pig-iron.—£16 16s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent., Si, £40 15s. 0d., scale 15s. per unit; 75 per cent., Si, £63 0s. 0d., Si, scale 16s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £230 0s. 0d. per ton; 38/40 per cent., £279 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 17s. 4d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 20s. 4d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £83 0s. 0d. to £86 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £81 0s. 0d. to £84 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C,* 1s. 11½d. per lb. Cr; 1 per cent. C,* 2s. 0d. per lb. Cr; 0.15 per cent. C,* 1s. 11d. to 2s. 1d. per lb. Cr; 0.10 per cent. C,* 1s. 11d. to 2s. 2d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d. per ton; 96/98 per cent., £269 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £53 17s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £26 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £27 19s. 0d.; hard (0.41 to 0.60 per cent. C), £29 5s. 6d.; silico-manganese, £36 7s. 6d.; free-cutting, £31 0s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £34 12s. 0d.; silico-manganese, £36 7s. 6d.

* Average 68-70 per cent.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £31 11s. 0d.; basic, hard, over 0.41 up to 0.60 per cent., C, £32 13s. 6d.; acid, up to 0.25 per cent. C, £35 12s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £33 1s. 6d.; boiler plates (N.-E. Coast), £35 11s. 6d.; floor plates (N.-E. Coast), £34 10s. 6d.; sectional material, N.-E. Coast, £30 19s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £33 19s. 6d.; flats, 5 in. wide and under, £33 19s. 6d.; hoop and strip, £35 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £36 5s. 0d.; black sheets (hand mill), 17/20 g., £46 13s. 6d.; galvanized corrugated sheets, 24 g., £54 14s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £58 0s. 3d.; nickel-chrome, £81 10s. 0d.; nickel-chrome-molybdenum, £92 7s. 6d.

NON-FERROUS METALS

Copper.—Cash, £363 0s. 0d. to £364 0s. 0d.; three months, £357 0s. 0d. to £357 10s. 0d.; settlement, £364 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 3s. 5⅞d. per lb.; rods, 408s. 6d. per cwt. basis; 20 s.w.g., 441s. 9d. per cwt.

Tin.—Cash, £765 0s. 0d. to £766 0s. 0d.; three months, £757 10s. 0d. to £758 10s. 0d.; settlement, £766 0s. 0d.

Lead (Refined Pig).—Second half July, £107 0s. 0d. to £107 5s. 0d.; second half October, £106 10s. 0d. to £106 15s. 0d.

Zinc.—Second half July, £89 10s. 0d. to £89 15s. 0d.; second half October, £90 5s. 0d. to £90 10s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £122 0s. 0d.; rolled zinc (boiler plates), all English destinations, £119 15s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £103 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 9d. per lb.; rods, drawn, 3s. 6⅝d.; sheets to 10 w.g., 352s. 0d. per cwt.; wire, 3s. 4¼d.; rolled metal, 337s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £217; B6 (85/15), —; BS249, —

Brass (High Tensile).—BS1400, HTB1 (30 tons), £273; HTB2 (38 tons),—; HTB3 (48 tons),—.

Gunmetal.—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £304; LG3 (86/7/5/2), £311; G1 (88/10/2/½), £383; (88/10/2/1), £375.

Phosphor Bronze.—BS1400, PB1 (AID released), £400 per ton.

Phosphor Bronze Strip, etc.—Strip, 494s. 0d. per cwt.; sheets to 10 w.g., 517s. 6d. per cwt.; wire, 5s. 0½d. per lb.; rods, 4s. 4⅝d.; tubes, 4s. 3d.; chill cast bars: solids 4s. 5d. cored 4s. 6d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 3d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 7½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 6½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 4d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £108 0s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £171 0s. 0d.; aluminium bronze (BS1400), AB1, £353; AB2, £369. Solder, brazing, BS1845, 2s. 11d. lb.; granulated, 3s. 3d. lb.

New Patents

(Copies of complete specifications are obtainable from the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3/-.)

732,005. Monsanto Chemical Company, 1,700, South Second Street, St. Louis, Missouri, U.S.A.

A foundry sand composition comprising sand, clay, water and a polymeric water-soluble polyelectrolyte with a weight-average molecular weight of at least 10,000 and a linear, continuous carbon-chain obtained by the polymerization of a compound which contains an aliphatic unsaturated group. The patent includes sample recipes for these sands.

732,118. Ford Motor Company, Limited, 88, Regent Street, London, W.1.

A method of making a resin-bonded sectional sand mould or core units in which the opposite faces of sectional mould or core-units are accurately formed to the desired dimensions. A finish suitable for casting is obtained by curing at approximately 288 deg. C.

732,147. Allied Ironfounders, Limited, 28, Brook Street, London, W.1.

Domestic fires of the space-heating open-grate type. The invention is to provide an improved construction of domestic fire in which the flue outlet may be controlled without causing smoking.

732,173. Buderus'sche Eisenwerke, 52-56, Sophienstrasse, Wetzlar, Germany.

A horizontally-arranged centrifugal casting machine in which the mould carrier, with the mould, is adapted to be displaced relatively to the trough of the liquefied material for the purpose of distributing the material over the full length of the mould.

732,298. National Lead Company, 111, Broadway, New York 6, New York, U.S.A.

An apparatus for precision casting of refractory metals, such as titanium and zirconium. The invention makes it possible to produce either large or small high-quality castings with virtually no metal contamination. The castings are of such precision as to considerably minimise the amount of subsequent machining or grinding. A detailed account of the apparatus and diagrams are given in the complete patent.

732,300. Robert Doat, 430, Rue des Vennes, Liège, Belgium.

A continuously-operable cupola furnace, with free slag discharge outlet, which is provided with a refractory lining, is the subject of this patent. The furnace is cooled externally over most of its outer surface. It is closed at its upper end and is fitted with a valve for maintaining a constant gas pressure. Two openings are provided, one in the side wall of the cupola is adjacent to the closed bottom for the passage of molten metal into a receiving chamber and a second at a higher level for the passage of slag into the chamber. This receiving chamber is divided into two parts for metal and slag, and has separate discharge spouts for each.

732,312. Electric Furnace Products Company Limited. Canada Life Building, Toronto, Canada.

A method for making nodular-graphite cast iron by adding calcium to a molten bath of grey cast iron. The bath should contain not more than 0.05 per cent. and not less than 0.02 per cent. sulphur and at least 3 per cent. silicon. The calcium added should be at least 0.05 per cent. of the weight of cast iron. The temperature of the bath should not exceed 1,500 deg. C.

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CLASSIFIED ADVERTISEMENTS

PREPAID RATES: Twenty words for 5s. (minimum charge) and 2d. per word thereafter. Box Numbers 2s. extra (including postage of replies).

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, John Adam House, 17/19, John Adam Street, Adelphi, London, W.C.2. If received by first post Tuesday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS WANTED

WORKS ENGINEER seeks new top level appointment U.K. or overseas (age 35). Comprehensive experience modern maintenance/development/mechanised foundries, associated plant, machine shops. Good background and qualifications.—Box WE394, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN (24), G.S. educated to H.S.C. standard. Practical training mech. G.I. foundry, D.O., patt. shop and laboratory. Experience control non-ferrous and shell. Will undertake complete retraining anywhere on results basis.—Box FF398, FOUNDRY TRADE JOURNAL.

FOUNDRY Planning Progress Manager (age 42) seeks position ASSISTANT FOUNDRY MANAGER or any progressive foundry position. Sound experience, practical, theoretical.—Box FP411, FOUNDRY TRADE JOURNAL.

FOUNDRY EXECUTIVE (32) requires management position. Graduate metallurgist, foundry apprenticeship, with excellent experience of light, medium and heavy carbon and high alloy steel casting production. Good knowledge of melting practice, methods, plant layout, etc., and fully experienced in all modern developments. Energetic and progressive. Salary important but secondary to future prospects. Box FE385, FOUNDRY TRADE JOURNAL.

NON-FERROUS FOREMAN. Skilled moulder, knowledge in all classes of foundry practice. Accustomed to full control. Experienced in floor, bench, plate and machine moulding. Training of unskilled labour. Box NF389, FOUNDRY TRADE JOURNAL.

EXPERIENCED FOUNDRY MANAGER/FOREMAN, grey or malleable, desires post Midlands. 15 years' executive, jobbing or mechanisation, costing, rate fixing. Practical technical.—Box EF392, FOUNDRY TRADE JOURNAL.

FOUNDRY WORKS MANAGER, age 45 (practical man), 18 years' managerial experience, seeks position. Sound experience in modern methods of production, grey, malleable and chilled iron, including shell moulding. M.I.B.F.—Box FW391, FOUNDRY TRADE JOURNAL.

EXPERIENCED FOUNDRY / SALES MANAGER (44), M.I.B.F., life experience trade, desires engagement Representative reputable firm. Cover Wales, Salop, Midlands. Car essential. Salary secondary. Commence immediately. References. — Box KC393, FOUNDRY TRADE JOURNAL.

ADVERTISER in executive position Manchester, with 50 years' experience Scrap Trade, is being placed on half-time 1st September. Seeks opening where remainder of week can be filled. Box AI388, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

BRASS Gravity Die Casting TECHNICIAN required for a growing Foundry specialising in the production of Plumbers' Brass-ware. Applicant must have a complete knowledge of this branch of the foundry trade and be capable of organising and maintaining a high rate of production. This is a position for a very energetic and determined personality. Age not exceeding 40. Salary in accordance with experience. Contributory pension scheme. Southern area.—Box BG326, FOUNDRY TRADE JOURNAL.

FOUNDRY ENGINEER wanted. Immediate duties will be mainly concerned with the layout of new Mechanised Plant, but would later extend to the control of works maintenance service. Salary in accordance with ability, and a generous pension scheme.—Apply in writing, giving details of previous experience, etc., to SHOTTON BROS., LTD., Manchester Street, Oldbury.

LARGE engineering works ten miles north of Manchester have a vacancy for a WORKING FOREMAN to commence early September for the NON-FERROUS department of their foundry. The post offers plenty of scope for advancement, to a man of initiative with ability to organize and manage the department with a minimum of supervision. Applications will be treated in strictest confidence which should state age, experience, full details of present employment and an idea of remuneration required and should be addressed to Box LE400, FOUNDRY TRADE JOURNAL.

METALLURGICAL CHEMIST, aged 25-30 years, required to take charge of laboratory and technical control in foundry producing Whiteheart Malleable and Grey Iron. General ability is as important as technical qualifications. Applications stating age, experience, and salary required, to :—BAGSHAWE & Co. LTD., Dunstable, Beds.

MIDLANDS REPRESENTATIVE required by Grey Iron Founders. Must be of proved ability and experience, and able to introduce new business.—Replies with reference required, stating age and salary required, Box MR412, FOUNDRY TRADE JOURNAL.

ENGINEER, age 23-29, good education (H.N.C., Mech. Eng.), some foundry experience advantageous, required by large foundry and engineering company in North Midlands.—State full particulars of education and experience to Box EA413, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—contd.

DEPUTY WORKS ENGINEER.—An engineer with sound experience in mechanical and electrical plant maintenance is required to assist Works Manager of foundry in Birmingham area. Qualification not less than H.N.C. standard (A.M.I.MechE. preferred). Practical experience with gas producer plant would be regarded as additional qualification. Salary £1,000 : preferred age 30/35. Box DW376, FOUNDRY TRADE JOURNAL.

SAND FOUNDRY ESTIMATOR AND PLANNING ENGINEER required in Ferrous and Light Alloy Foundry. Pension Scheme operated.—State age and salary required to PERSONNEL MANAGER, Kent Alloys, Ltd., Rochester, Kent.

LABORATORY ASSISTANT required for small Steel Foundry to take charge of Rotary Furnace producing Steel Castings, also Sand Control. (All Night Work). Applications state age, qualifications and experience. Box LA379, FOUNDRY TRADE JOURNAL.

VITREOUS ENAMEL/GLASS AND REFRACTORY TECHNOLOGISTS are required for Research and Development Work on Vitreous Enamels and General Ceramics at Laboratories situated in Warrington. Whilst University Graduates are preferred, candidates having industrial experience in one of the Ceramic fields are invited to apply for these vacancies.—Replies should be addressed to: RADIATION CERAMICS RESEARCH DEPARTMENT, Richmonds Gas Stove Co., Ltd., Grappenhall Works, Warrington.

REQUIRED, for African Malleable Foundries, Benoni, near Johannesburg, QUALIFIED METALLURGIST, preferably with experience with malleable and grey iron. Salary in accordance with qualifications and experience, but not less than £1,200 per annum.—Applications to ASSOCIATED ELECTRICAL INDUSTRIES OVERSEAS, LTD., Crown House, Aldwych, London, W.C.2.

ASSISTANT FOUNDRY MANAGER required by mechanised grey and malleable ironfounders, Wolverhampton area. Applicants should have good knowledge of machine moulding methods and ability to control labour. Knowledge of cupola and sand control is essential and preference will be given to applicant having been trained in method study procedure. Good progressive position for right man. Apply giving details of age and experience to Box AF375, FOUNDRY TRADE JOURNAL.

CHIEF DRAUGHTSMAN required, having experience of General Engineering and Plant Layout; experience of Jig and Tool design advantageous but not essential. Applicants should apply, in writing, stating age, past experience, and salary required to: THE SECRETARY of The North British Steel Foundry Limited, Balbardie Steel Works, Bathgate.